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ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE of TECHNOLOGY

ustrial Development Division

1132 W. Peachtree Street
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February 15, 1968

Mr. Harold Hale, Director
Office of Technical Services
University System of Georgia
724 Hartford Building
100 Edgewood Avenue, N. E.
Atlanta, Georgia 30303

Dear Harold:

Enclosed are the industry analyses which have been completed as Georgia Tech's part of the revision of the State Technical Services Five-Year Plan. These analyses have been prepared for ten Standard Industrial Classification (SIC) categories in Georgia as listed below. Two sets of each analysis are included.

SIC 14 Mining and Quarrying of Nonmetallic Minerals
SIC 22 Textile Mill Products
SIC 23 Apparel and Related Products
SIC 28 Chemicals and Allied Products
SIC 30 Rubber and Plastics Products
SIC 33 Primary Metal Industries
SIC 34 Fabricated Metal Products
SIC 35 Machinery, Except Electrical
SIC 36 Electrical Machinery
SIC 38 Instruments and Related Products

Sincerely,

Rudolph L. Yobs
Campus Coordinator

RLY:mpc
Enclosures

cc: Mr. Robert E. Stiemke
Mr. Ross W. Hammond

MINING AND QUARRYING OF NONMETALLIC MINERALS
(Standard Industrial Classification 14)

The Industry in the United States

Identification

The industry classified as mining and quarrying of nonmetallic minerals (SIC 14) consists of approximately 8,500 establishments in the United States engaged principally in the exploration and extraction of nonmetallic minerals, except fuels. Major segments of the industry center around (1) the mining or quarrying of dimension stone; (2) the mining or quarrying of crushed and broken stone; (3) the dredging, washing, and screening of sand and gravel; (4) the mining, milling, and preparation of clay, ceramic, and refractory minerals; (5) chemical and fertilizer mineral mining; (6) nonmetallic minerals services; and (7) the mining, quarrying, or milling of miscellaneous nonmetallic minerals such as gypsum, mica, asphalt and bitumens, pumice and pumicite, talc, soapstone, prophyllite, natural abrasives, peat, asbestos, diatomite, natural gem stones, graphite, and vermiculite.

Many firms which mine or quarry nonmetallic minerals also are involved in the further processing of the minerals and therefore may be classified in a manufacturing category as well as -- or instead of -- the mining category. Closely associated manufacturing categories include stone, clay, glass, and concrete products (SIC 32) and, to a lesser degree, chemicals and allied products (SIC 28).

Composition

Approximately 70% of the more than 120,000 employees in the nonmetallic minerals industry in the United States are concentrated in two segments of the industry -- crushed and broken stone and sand and gravel. Another 25% of the industry's total employment is involved in chemical and fertilizer mineral mining and in mining, milling, or otherwise preparing clays and refractory minerals.

Growth Pattern

Growth in the nonmetallic minerals industry has been relatively slow in the past, particularly in terms of total industry employment. Between the

census years of 1958 and 1963, for example, total employment increased only slightly more than 2%. With the exception of crushed and broken stone and sand and gravel, all segments of the industry actually declined in employment during the 1958-1963 period.

Employment figures alone conceal somewhat the actual growth which has taken place in the industry, however. As a result of technological advances in mining and quarrying equipment and methods, the value added in mining increased approximately 22% from $1.4 billion to $1.7 billion between 1958 and 1963. All segments of the industry shared in this increase in value added in mining: nonmetallic minerals services (50%); clay, ceramic, and refractory minerals (30%); crushed and broken stone (29%); chemical and fertilizer mineral mining (28%); miscellaneous nonmetallic minerals (25%); sand and gravel (18%); and dimension stone (13%) (1).

Outlook

The outlook for the nonmetallic minerals industry as an employment source is not encouraging. The application of technological developments in mining and quarrying should continue at an accelerated pace, and the value added per worker should increase significantly, while total employment is likely to remain relatively stable or actually decline. Major growth in the industry should continue to be concentrated in the two largest industry segments -- crushed and broken stone and sand and gravel -- since the demand for these products is closely tied to the booming construction market.

The Industry in Georgia

Composition

The nonmetallic minerals industry in Georgia includes the mining, quarrying, or processing of dimension stone (granite, marble, and sandstone); crushed and broken stone (limestone, marble, slate, and granite); sand and gravel; clay, ceramic, and refractory minerals (kaolin, fuller's earth, feldspar, fire clay, and kyanite); chemical and fertilizer minerals (barite and ocher); and miscellaneous nonmetallic minerals (mica, peat, talc, and soapstone).

Kaolin dominates the nonmetallic minerals industry in Georgia. More than 10% of the total employment in the state's nonmetallic minerals industry is concentrated in kaolin mining, and this activity accounts for more than half

of Georgia's total value added in mining nonmetallic minerals. Almost 70% of the nation's kaolin workers are employed in Georgia, and the state produces approximately 75% of the total kaolin output of the United States.

The mining or quarrying of crushed and broken stone is the only other major segment of the nonmetallic minerals industry in Georgia, accounting for more than 30% of the industry's total employment and approximately the same percentage of the total value added in mining. This industry segment, together with the clay, ceramic, and refractory minerals segment (including kaolin), covers more than 85% of the employment and more than 90% of the value added in mining nonmetallic minerals in Georgia.

Industry statistics, which indicate that dimension stone is the smallest segment of the state's nonmetallic minerals industry (except miscellaneous minerals), obscure the fact that the Elberton area is one of the three major monumental granite regions of the United States and that the Georgia Marble Company is considered the largest marble producer in the world. A major part of the Elberton granite industry is classified in the stone, clay, glass, and concrete products category (SIC 32), and the output of the Georgia Marble Company is largely concentrated in the crushed and broken stone segment of the nonmetallic minerals industry.

Location

Firms engaged primarily in the mining or quarrying of nonmetallic minerals are located in 67 of Georgia's 159 counties. Most of the minerals are highly concentrated geographically. Although kaolin deposits occur sporadically in many locations, particularly along the Fall Line, the chief kaolin-producing counties are Twiggs, Wilkinson, and Washington. A major marble belt extends from Fannin County southwestward, centering in Pickens County. Monumental granite is quarried chiefly in Elbert and surrounding counties, while crushed granite operations are concentrated in DeKalb and surrounding counties. Sands and gravels are widely distributed throughout the state, with Brooks, Crawford, Muscogee, Talbot, Taylor, and Thomas being the principal producing counties.

Growth Pattern

The two major segments of Georgia's nonmetallic minerals industry -- kaolin and crushed and broken stone -- have grown rapidly in recent years, while all other segments have declined in employment and value added in mining.

Between the census years of 1958 and 1963, employment associated with kaolin mining increased 8%, and value added in mining increased 78%. Employment in quarrying crushed and broken stone increased even more dramatically (26%), but value added in mining increased only 30%. The net effect of these growth segments on the overall industry was a steady increase in both employment (up 8% in 1963 over 1958) and value added in mining (up 45%) (2).

Trends

Major growth in Georgia's nonmetallic minerals industry should continue to be in mining kaolin and crushed and broken stone. The uses of kaolin are traditionally in ceramics and as a filler or coating, particularly for the paper and rubber industries, and these uses should continue to expand with the years. Technological improvements and new processes, such as treating clays with radioactive materials, may change the characteristics and open entirely new fields for kaolin. Significant new work is being done in the surface chemistry and physics of the clay particle. All of this may lead to improvements, new products, and market expansions.

The demand for crushed and broken stone -- as well as for sand and gravel -- depends primarily upon construction and particularly upon highway paving. The upward trend in highway construction is expected to continue for many years. Building construction volume also may be expected to continue to expand during the next decade and, as a result, a continuing steady demand for crushed and broken stone and sand and gravel can be anticipated.

Any significant growth in the demand for dimension stone must depend upon the development of new uses and vigorous promotion of existing uses. Increased use of architectural marble, for example, could capitalize on the current building boom and favorably affect the future demand for dimensional marble. The demand for monumental granite has been and will continue to be seriously affected by the growth of no-monument cemeteries unless this competition is effectively overcome. The development of new uses for dimensional granite, particularly that which is currently discarded, also is essential to the long-term growth of this segment of the industry.

Industry Problems and Needs

Basis of Analysis

The ensuing analysis of the problems and needs of the nonmetallic minerals industry in Georgia is based on the following: (1) personal interviews with managers and operators of 85 firms engaged in mining or quarrying nonmetallic minerals (SIC 14) and/or in processing these minerals (SIC 32), including 30 firms that are primarily involved in mining or quarrying operations; (2) the responses to a mail survey of problems and needs received from 91 firms engaged in mining or quarrying nonmetallic minerals (SIC 14) and/or in processing these minerals (SIC 32), including 16 firms that are primarily involved in mining or quarrying operations; and (3) previous studies conducted by the Industrial Development Division, including an analysis of the past, present, and future status of Georgia's mineral resources and a comprehensive program of research and technical assistance for the granite industry in Elbert County.

Nontechnical Problems and Needs

Management and other nontechnical problems in the nonmetallic mining industry in Georgia differ little from those in other types of industrial activity in the state. The most common problems are those relating to the management of manpower -- finding "good" employees, developing first-line supervisors, retaining employees, developing satisfactory employee relations, and meeting the competition of higher-paying industries. Other problems which are generally prevalent in the industry and which are not confined to any specific industry segment are those relating to cost control, production scheduling, quality control, organizational planning, sales promotion, diversification, accounting methods, and securing outside financing.

Technical Problems and Needs

Since all types of mining and quarrying operations depend heavily on specialized equipment in exploring sources of raw materials and in extracting and handling bulk materials, the most universal area of technical interest in this industry is in the design and development of drilling, dredging, milling, conveying, and other types of extracting and materials-handling equipment which will increase operating efficiency and reduce maintenance costs. Specific

technical problems and needs of individual segments of the industry include the following:

Dimension Stone. A critical need in the monumental granite industry in the Elberton area is for an economical means of utilizing waste granite resulting from the quarrying as well as the processing operations. Because of the high quality of stone required in monumental work, much of the granite must be rejected. The hardness of the granite precludes the economical use of conventional crushing equipment in reducing the size of the waste for traditional construction uses. Advances in technology which could lead to the development of more efficient crushing equipment or techniques for breaking granite down into its individual mineral constituents would contribute significantly to the solution of a growing solid waste disposal problem and to the more efficient use of natural resources.

Sand and Gravel. Individual firms in this segment of the industry are particularly interested in improved quality-control techniques, advanced methods of sand particle separation, new uses for silica sand, and the development of additional outlets for extra fine grain sand.

Clay, Ceramic, and Refractory Minerals. Advances in technology in the aluminum industry may radically change the outlook for Georgia bauxite and related high-alumina clays, including kaolins. For this reason, the kaolin producers in Georgia are vitally interested in technical information relating to new developments in the production of alumina from kaolin. Other areas of common interest to miners of kaolin and other clays are new sources of deposits, new end uses for clay, the utilization of waste and by-products, more efficient processing methods, and quality-control techniques.

Other Nonmetallic Minerals. Producers of crushed and broken stone have a particular interest in the development of new crushing techniques and in the location and development of raw material sources. A talc-mining firm has expressed an interest in research and development on the beneficiation of talc-bearing ore. A producer of mica has requested technical information and service on new developments in ore separation techniques.

Conclusions and Recommendations

1. Many of the major firms engaged in mining or quarrying nonmetallic minerals also are involved in processing the minerals after they are extracted. Since the processing operations are generally classified under another industry category and since the technical problems of extraction and processing may differ, these conclusions and recommendations should be considered in conjunction with those for the stone, clay, glass, and concrete products industry (SIC 32) in determining how the Georgia Technical Services program can best serve the dual-function firms in the two industry groups.

2. A special effort should be made under the Georgia Technical Services program to provide technical information and service to those firms in the state that are involved in mining and processing kaolin. This segment of the nonmetallic minerals industry warrants special attention not only because Georgia is the leading kaolin-producing state in the nation, but also because the potential for effective technology transfer is particularly promising. The fact that many of the operations are relatively large (Freeport Kaolin Company, Minerals and Chemicals Philipp Corporation, Georgia Kaolin Company, etc.) and that some maintain research and technical staffs does not mean that the firms could not benefit from the State Technical Services program. In fact, considerable interest has been expressed by individual firms in being kept informed of technological developments which might be applied in the industry, and the presence of technical staffs should facilitate the transfer of any applicable technology.

3. The granite industry in the Elberton area lends itself especially well to a group-assistance project under the Georgia Technical Services program. Highly concentrated geographically, the Elberton granite industry consists of approximately 60 small to medium-size quarriers and processors of granite monuments and some building stone. Although the quarrying operations represent only a minor segment of the state's nonmetallic minerals industry, the inclusion of the processing operations (SIC 32) makes the area one of the three leading producers of monumental granite in the United States. The industry's receptiveness to changes in technology is bolstered by an active, progressive trade association, through which technical information and service could be channeled.

4. With the exceptions noted above, it is concluded that the other segments of the nonmetallic minerals industry in Georgia could best be served on an individual firm basis as part of a general industrial extension service under Georgia's State Technical Services program.

* * *

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TEXTILE MILL PRODUCTS
(Standard Industrial Classification 22)

The Industry in the United States

Size and Location

The textile industry (SIC 22) is a major national employer, with 953,500 persons employed as of September 1967 (8). There are more than 7,000 establishments throughout the United States; however, more than 50% of total employment is located in Georgia, North Carolina, and South Carolina.

Historically, the textile industry has been highly fragmented, with most plants small and family-owned. This has contributed to its public image as a tradition-bound and economically backward industry. However, in the last 20 years the trend has been toward larger companies, as many of the small family-owned plants have either closed or been merged with larger units. But even today, with the trend toward large, vertically integrated companies, no single textile firm accounts for as much as 8% of the industry's sales.

Growth Pattern

The most significant fact about the U. S. textile industry today is the marked improvement which has occurred in its position since the late 1950's. Production employment, which had stood at 1,146,300 in 1947, had dropped to 826,000 by 1958 (10). During the same period, some 175 southern mills, involving 42,200 employees were reported as liquidated (3). The textile mill operating rate had dropped to 80% of capacity in 1958 (3). The industry was generally regarded as being in a depressed condition.

However, since that time, the industry has shown considerably more vitality. From 1957 to 1964 output rose 3.5% annually, which was considerably higher than the 1.3% rate from 1947 to 1957. Value of total shipments increased from $13.5 billion in 1958 to $21.6 billion in 1967. Production employment increased to the 950,000 level by 1967. Textile mill profits jumped from $189 million in 1958 to an estimated $745 million in 1967. Average hourly wages rose from $1.63 in 1961 to $2.06 in 1967; a further general wage increase of 6.5% occurred in September 1967.

Significant Changes

During the past decade, the industry has undergone a number of substantial changes; these are briefly summarized below.

Market Growth. The three major markets for textiles are apparel, home furnishings, and industrial products. They account for 41.8%, 27.3%, and 17.2% of the total fiber consumption, respectively. The remainder goes into various consumer uses (10%) and exports (3%). The market for apparel is directly related to two factors -- population and disposable income -- and has increased in proportion to their increase. Consumption of fiber in apparel has increased from 2,767 million pounds in 1959 to 3,850 million pounds in 1967. Home furnishings increased from 1,651 billion pounds to 2,610 billion pounds during the same period, and industrial uses accounted for a moderate increase from 1,303 billion to 1,570 billion pounds despite growing competition from paper and plastics (4).

Increased Capital Expenditures for Modernization and Expansion. Capital expenditures in the textile industry increased from $412 million in 1959 to $1.2 billion in 1966. The 1967 expenditures are expected to be off slightly, but still in the billion-dollar range. In 1958, 70% of investment went into plant modernization and 30% into expansion. By 1965, this ratio had changed to 55% and 45%, respectively. Most significantly, investment per employee for mills built in the mid-1960's has approximated $50,000 as opposed to $6,000-$10,000 for older mills.

Increased Productivity. A substantially higher level of investment in plant and equipment, together with more sophisticated management, has resulted in marked improvements in labor productivity. In the period 1955-1965, the textile production index rose 34% while employment declined 11%. The introduction of equipment using larger packages and higher speeds has more than offset the retirement of marginal mills and obsolete equipment. Formerly highly labor-intensive, some newly modernized mills have reported reductions of 25% in unskilled jobs in the past five years.

Increased Research and Development. Although expenditures for research and development in the textile and apparel industries are relatively low as a percentage of sales, estimated to be 0.19% in 1966 (5), dollar volume has grown rapidly in recent years. Only $15 million were spent for R & D in 1957; in 1967 this figure is estimated to approach $40 million (5). In addition, chemical and machinery manufacturers, which historically have supplied most

innovations and technology to the textile industry, made substantial outlays for research, as did the U. S. Department of Agriculture in the case of natural fibers.

New materials and products have become increasingly important. New products (those less than 10 years old) constituted 22% of sales in 1963, and McGraw-Hill estimates that this will increase to 35% by 1973. Man-made fibers have continued the long-term trend of taking an increasing percentage of total fiber consumption. Although total consumption of cotton and man-made fibers has increased with market demand, cotton's share has been steadily decreasing. Between 1954 and 1965 cotton's share of the fiber market dropped from 68.5% to 52.7%, while man-made fibers increased their share from 25% to almost 43%. This shift has been a reflection of the many desirable properties which the use of synthetics makes possible in textile products.

Among the product developments which have contributed to textile growth are durable press fabrics for apparel, bonded plastic-fabric laminates, tufted carpets, and tricot (or warp-knit) fabrics.

Modern Management. The emergence of larger companies run by managers with professional training has been a vital factor in the improved position of the textile industry. Modernization of mills, acceptance of new products and processes, development of more aggressive marketing techniques, and new inventory practices have all been accelerated by professional management. The institution of more responsive inventory controls has been of special importance since historically the swings in profits accentuated by poor inventory practices have had more effect on textile activity than actual volume of sales. The present trend is toward gearing production more closely to short-term demand, as shown by the increase of average annual inventory turnover from 5.7 in 1957-1958 to 6.6 in 1965 (4).

Outlook for the Industry

For the period 1967-1976, the following trends have been projected for the textile industry (11).

1. Output will increase. Manufacturers' sales will reach $32 billion by 1976, an increase of 57%. Volume of physical production will increase 45%. An increased level of industrial and general economic activity, together with a

substantial increase in the key textile-consuming age group (20-39) and increased personal incomes will be responsible.

2. Employment will decline, but at a gradual rate. Emphasis will be on higher skills and more responsible job assignments. Wage levels will continue to approach national averages for manufacturing.

3. Capital investment in new plants and equipment will continue to increase, and is expected to reach $2.25 billion annually in 1976 as compared with $1.13 billion in 1966. Average investment per employee, already at the $50,000 level for newer mills versus $6,000-$10,000 for old mills, will continue to rise. Investment in new plants and expansions will increase relative to expenditures for modernization of old plants. Productivity and value added should increase proportionally.

4. R & D expenditures will continue to increase. McGraw-Hill has forecast R & D outlays by the textile and apparel industry at $54 million by 1974 as compared with $36 million in 1964 and $15 million in 1957. This will amount to only about 0.5% of sales, but a substantial percentage of total textile research is performed by machinery manufacturers, synthetic fiber producers, and the U. S. Department of Agriculture. However, research expenditures by the mills themselves will increase as a function of increasing corporate size and management sophistication. New textile products (less than 10 years old) will account for 35% of sales as opposed to 22% in 1963.

5. Increasing emphasis will be placed on the use of advanced instrumentation and controls and on automated materials-transfer systems. Greater technical competence will be required of employees.

The Textile Industry in Georgia

The Industry as a Whole

Composition. The textile industry is the largest source of manufacturing employment in Georgia, with 108,600 persons reported working in the industry in 1966 (10). Some 370 plants are located in 80 counties, most of them concentrated above the Fall Line. More than one-half of the textile employment is in broad-woven fabric mills. Slightly less than 10% is in knitting mills, primarily hosiery. Floor covering mills -- tufted textiles -- are an important and unique segment of Georgia's textile industry and account for an estimated

15% to 20% of total textile employment. The remainder of the industry is made up of dyeing and finishing, felt goods, paddings and fillings, and other miscellaneous textile operations.

Wage and Output Trends. Average earnings in the textile industry in Georgia, which have lagged behind the national average, have increased both in absolute terms and in relation to the national figure. However, the average hourly wage in textile manufacturing, reported at $2.06 in November 1967, is still markedly below the overall production workers' average of $2.24 from all manufacturing in the state (2). Value added by manufacture per employee in Georgia has increased very substantially in recent years and is approaching the national textile industry average. By 1963, this figure had reached 95.2% of the national average, and the proportion is estimated to rise further by 1968.

Outlook. The outlook for the Georgia textile industry is favorable, with annual growth in output expected to average 4% to 5% over the next five years. However, employment is expected to remain close to present levels because of increasing productivity. Wage levels should rise as increasing capital investment in new equipment will create needs for more skills.

Tufted Textiles

Composition. A unique feature of the textile industry in Georgia is the presence of approximately 125 tufting mills employing more than 18,000 people (1). This segment of the industry has evolved largely in the Dalton area, and the state still contains about 60% of the U. S. tufting activity. The principal product is carpeting, although chenille products (e.g., bedspreads and bathmats) also are produced.

Characteristics. The tufted textile industry differs in a number of ways from the conventional textile industry. The carpet tufting process is relatively new, having been developed after World War II as a variation of the chenille process. Its use grew rapidly, largely because of four factors: (1) the competitive cost advantage offered over woven carpets, (2) the increase in home-building during the 1950's, (3) increase in disposable income, and (4) the introduction of synthetic fibers with long-wearing, easy-care properties which were desirable in carpets. The industry is "home-grown" in the sense that it developed most of its own technology as it grew. Large companies became suppliers after realizing the markets the new industry represented, but, initially at least, contributed little technology.

The industry is still characterized by a large number of producing units, owned and operated by entrepreneurs, although there has been some movement toward both the entry of larger firms and the consolidation of smaller mills into larger producing units.

Outlook. The rapid growth of the industry is evidenced by the fact that 1966 sales of $1.3 billion were double those of 1961 (9). Continued growth is expected, with industry production of 663,850,000 square yards projected for 1975, which would represent an increase of approximately 78% over that of 1966 (7). A similar percentage increase in employment would indicate 28,500 persons working in the tufting industry by 1975. Although economies of scale probably would diminish this number somewhat, it appears that the tufting industry will continue to grow as a major element in the state's economy.

Industry Problems and Needs

Textiles, except Tufted

Despite the fact that the outlook for the industry is now more favorable than it has been in years, there are still a number of problem areas. Two that are frequently cited by those in the industry are (1) competition from imports, particularly in man-made fiber goods, and (2) difficulty in acquiring and holding well-qualified personnel. To these must be added a third area -- the need to stay abreast of, and take advantage of, continuing technological developments, some of which could effect drastic changes in the composition of the industry.

Technological Changes. For example, the technology of nonwoven materials continues to advance; conceivably the time may come when most fabric may be made by direct conversion from fiber, thus eliminating the conventional processes of spinning and weaving. Although this is not considered a strong possibility by most in the industry, it was precisely this type of change which enabled tufted carpets to displace woven carpets. In the event that the corporate "conglomerates" should enter the textile field on a broad scale, their financial resources and aggressive management would almost certainly accelerate changes of this type.

Competition from Imports. The first two problem areas mentioned above are closely related. The increase in imports of man-made fiber goods (cotton goods

are controlled under a 1962 international agreement) has been concentrated in the lower price ranges. Although it appears likely that there will be some protection for the domestic industry in the form of legislation or international agreement, it does not appear likely that the pressure of imports will be entirely relieved. Therefore, the domestic industry will be faced with the need for still more technical and product innovation, greater capital investment, and sophisticated management in order to maintain an advantage over foreign competition.

Manpower. In order to sustain this kind of growth, the textile industry will need to attract and retain well-qualified technical personnel. In this regard the industry's poor public image has been a severe handicap. Science and engineering graduates are not attracted to an industry with the reputation of being "backward." Despite advances in recent years in wage levels, the industry still lags behind the national averages for most categories of manufacturing. In the past this low wage level has been caused in part by periodic over-accumulation of inventories and resultant sell-offs. These cyclical fluctuations often exerted more influence on profits than did actual costs of production (6). However, modernization of the industry is resulting in the elimination of this practice. This factor should strengthen the wage structure, as should increasing productivity and increasing competition for labor as those regions in which the industry is concentrated become more heavily industrialized.

Tufted Textiles

During the 1950's and 1960's the tufting industry experienced very rapid growth because of the strong demand for its product. Entry into the industry was relatively easy and many new companies were established. However, the industry is now maturing; larger corporations have entered the field, and management and production techniques are becoming more sophisticated. As a rule, the larger companies are better equipped to take advantage of these more advanced techniques, which will increase the competitive pressures on small and medium-size companies.

A Georgia Tech survey of 23 tufting firms to determine principal problems of companies in the field showed that 38% cited operational problems, such as production scheduling and methods and quality and inventory control. The area of marketing, distribution, and sales was cited in 25% of the responses, and

problems related to personnel and training were cited by 15%. Only 7% cited needs which could be classified as research or development.

Conclusions and Recommendations

Textiles, except Tufted

Traditionally, fabric mills have been users, not developers, of technology. Most innovations have been brought about by machinery manufacturers, producers of chemicals or synthetic fibers (the U. S. Department of Agriculture in the case of natural fibers), or the requirements of the ultimate customers. These are expected to remain the primary channels through which technology will enter the industry.

However, research is becoming more the direct concern of fabric-producing mills themselves. Although there are in Georgia few of the large-scale textile research organizations of corporate giants, such as Burlington and Deering Milliken, found in the Carolinas (West Point-Pepperell is an exception), there is a considerable amount of textile research and development activity. For example, the Directory of Scientific Resources in Georgia, 1966-67 lists 15 mills which have an identified R & D function, with an average of almost three professional persons per mill working in this category.

Much of the effort of these small technical groups is probably devoted to non-R & D functions, such as quality control, customer service, or in-plant problem solving. The University System could provide assistance in such cases in the form of consultation with subject area specialists. The services of an industrial extension agent would be of less benefit because the competence is already present in the technical groups to handle most general production problems. Rather the need is to back them up with a higher level of technical competence than they already possess. For example, a plant engineer working on a machinery problem might not need further engineering help, but consultation with a metallurgist on metal fatigue instead. Examples of the subject areas in which such assistance would be of interest to the textile industry are (1) automated production systems, (2) instrumentation and controls, (3) transfer of materials, (4) computerized control of color matching, (5) chemistry of finishes, and (6) machine efficiency.

Tufted Textiles

As the tufted industry matures, major suppliers, particularly chemical fiber producers, are taking a larger role in advancement of the product (for example, polypropylene outdoor carpet), and machinery manufacturers, of course, are active in the development of equipment. The principal needs of the small and medium-size tufters will be (1) to insure application of good engineering and management practices in order to strengthen their competitive positions; (2) to stay abreast of new developments in the industry and adapt them to their own operations; and (3) to find ways of coping with related problems, such as effective disposal of synthetic fiber waste.

Some specific areas of technology in which direct assistance could be useful to the tufting industry are (1) management tools and procedures; (2) dyeing processes, including instrumented color matching; (3) carpet backing materials and techniques; (4) tufting machine efficiency; (5) pattern control devices; (6) disposal of nondegradable wastes; and (7) general engineering practices.

The relatively high degree of concentration of the tufting industry in northwest Georgia, particularly in the Dalton area, and the common production technology shared by the industry point up the possibility for basing industrial extension activity of the University System in Dalton to serve the industry. Such a service could provide current information on technological developments, advice and suggestions on engineering and management practices, and act in effect as a clearinghouse for information and contact point for obtaining assistance. It could not be expected to provide a research and development function for individual companies which might involve proprietary interests.

* * *

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APPAREL AND RELATED PRODUCTS
(Standard Industrial Classification 23)

The Industry in the United States

Identification

The apparel and related products industry (SIC 23) produces all types of men's, women's, and children's clothing; related items, e.g., caps, gloves, and raincoats; household goods, e.g., drapes, seatcovers, pillows, and mops; and industrial items, e.g., bags, canvas goods, and wiping cloths.

Industry Characteristics

The industry consists of approximately 30,000 producers, of which some 56% employ less than 20 persons. No single producer accounts for more than 2% of industry sales. Approximately 1.4 million people were employed in the industry in 1966, with more than 40% of these concentrated in New York, New Jersey, and Pennsylvania. A number of the southern states also have substantial employment in apparel.

Expenditures for apparel and accessories show a close correlation with disposable personal income, tending to average approximately 6.5%, and sales have risen in line with general prosperity in recent years. Consumer expenditures in this category have increased rather steadily from a figure of $18.5 billion in 1953 to $32.5 billion in 1966 (2).

The pace of apparel production has accelerated in recent years in response to heavier demands created by the rising levels of population and income. Federal Reserve Board data show an average annual increase in output of 4.8% from 1957 to 1964 as compared with a 2.7% annual rate of growth from 1947 to 1957.

Profit margins in the industry are typically quite low. In 1965, profits after taxes amounted to 2.3% of sales compared to 5.6% for all manufacturing. This low return reflects labor-intensive production methods which have remained basically the same for many years. The large number of producers makes for very close pricing, and rapidly changing styles frequently force inventory markdowns. The industry is the lowest-ranking among the 20 major manufacturing industries in respect to net assets invested per production worker and in value added per production worker. All of these factors contribute to the prevailing low wage structure throughout the industry.

Significant Trends

1. Continued growth is foreseen, but only at a moderate rate. The relation between apparel consumption and disposable personal income and population growth is expected to result in increased production, but a part of this production probably will be imported (in some cases, from the overseas plants of American companies).

2. Modernization and automation of apparel plants will continue to increase, but not rapidly enough to alter the basic character of the industry. Nonstandard production runs will restrict mechanization. However, competitive pressures will force the use of new technology wherever possible, and the larger producers of more standard items will employ engineering techniques, computers, etc., to increase efficiency.

3. The use of new processes, materials, and fibers will become increasingly important. Bonded fabrics, fused seams, nonwovens, permanent crease resin finishes, and new knit constructions probably will be used increasingly by designers seeking the new and unusual. Such new materials and processes will involve a higher technology content than more standard production items.

4. Expenditures for new plant and equipment are expected to rise, and this trend will be reinforced by continuing mergers and acquisitions in the industry. However, the industry's average capital investment per production worker is still the lowest for all manufacturing industries.

The Industry in Georgia

Location

The apparel and related products industry is a major employer in Georgia. With some 57,200 employees in 418 plants throughout the state, this group ranks second only to textiles (SIC 22) in total employment (1). Geographically, the industry is well dispersed throughout the state, with plants operating in 122 of Georgia's 159 counties. However, a preponderance of employment is concentrated in counties in the Piedmont plateau region. The Fulton-DeKalb County area represents a localized concentration, with 89 plants employing 7,700 people.

Composition

More than 56% of the industry's employment in Georgia is in the manufacture of men's and boys' clothing. Approximately 29% is in women's and children's apparel, and the remainder is concentrated in some 153 companies making a wide variety of items, such as robes, gloves, household furnishings, bags, canvas goods, and mops (1).

Wages in Georgia tend to fall below the national average for this industry, reflecting the concentration in the lower-value lines of apparel. In 1966 average weekly earnings were $59.97, or 87.2% of the U. S. average for apparel (3).

Apparel manufacture in Georgia is not restricted to small plant operations; 40 plants employ 500 people or more. Many of these, e. g., the Arrow Company plant in Atlanta (1,600 employees) and Manhattan Shirt Company in Americus (800 employees), are branch plants of major national firms. Others, e.g., the Bremen-Bowdon Investment Company at Bowden (1,200 employees), Sewell Manufacturing Company at Bremen (1,500 employees), and The Lovable Company at Atlanta (1,300 employees), are locally owned and managed. A second type of company is represented by the many so-called "cut and sew" or contract sewing operations found throughout Georgia and typically having from 50 to 200 employees. The third type of company is found principally in the related products group and includes many small owner-operated plants for making such items as mops and seat covers.

Industry Problems and Needs

Basis of Analysis

This analysis of the problems and needs of the apparel and related products industry is based, in general, upon the experience of Industrial Development Division personnel in working with Georgia industry for more than 11 years. Specifically, it makes use of three extensive surveys in which owners and managers of 209 apparel plants were asked to express their particular problems and needs.

General Management Assistance

This is the area of need most often cited by plant owners and managers and apparently represents the large number of smaller firms which lack some of the management resources available in larger companies. It includes such specific

topics as marketing, finance, and transportation. However, the great preponderance of problems cited deal in some way with personnel. Difficulties in recruiting, training, and maintaining work forces are among the problems most frequently mentioned. This reflects the labor-intensive, low-wage nature of the industry and the fact that, in a production-oriented situation, personnel problems are the most obvious and most distressing for line management.

Technical Problems and Needs

Production Controls and Related Areas. This area of need ranks second in frequency of mention only to general management assistance. Specific problem areas include production methods, layout and scheduling, quality control, materials handling, and the closely related topics of cost controls and accounting. Again, this reflects the production-consciousness of the apparel industry.

Access to Engineering and Scientific Know-How. Several of the larger locally owned apparel producers have from time to time approached Georgia Tech on technical problems involving consultation or limited research and development efforts. These firms are large enough to have engineering and technical staff capabilities but still have a certain need for highly specialized assistance or services on particular problems.

Other Areas. Problems related to manpower and production controls comprised the great bulk of those actually mentioned in plant surveys and visits. However, some additional areas of need were also cited. These included specific technical problems, such as seam pucker, formaldehyde fume removal, and waste disposal. Also mentioned was the need for information on markets and on new technological developments, particularly that involving new automatic processing machinery.

Conclusions and Recommendations

1. The apparel and related products industry is a major employer in Georgia. Although relatively low-wage, it provides a needed source of income in many rural and small-town areas, particularly for women who supplement the family income. Highly labor-intensive, the industry is undergoing a degree of mechanization and automation. This is not expected to change the character of the industry in the foreseeable future, however. Overall, the industry should continue to experience gradual growth, but it is coming under increasing competitive

pressures from imports of foreign-made apparel. Pressure is felt particularly on the lower-priced lines, many of which are manufactured in Georgia. Since this situation could present a serious problem for the state, assistance programs need to be offered to help strengthen the industry's position.

2. Assistance in general management practices, particularly personnel procedures, is believed to be the greatest single need of plant owners and managers. Smaller firms can benefit from the type of aid offered through a general industrial extension service. Personnel and labor problems can probably best be handled through the marshalling of existing state and federal manpower services or the use of private consultants specializing in this field.

3. Production technology and closely related areas offer a field in which a specific technical-service effort could possibly be offered for direct benefit to the industry. This, together with the size of the industry in Georgia, could probably justify a technology-oriented project directed to the problem areas of the industry.

4. There should be a means for those firms with technological problems which have their own technical staffs to have ready access to the more advanced research capabilities in the University System.

* * *

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CHEMICALS AND ALLIED PRODUCTS
(Standard Industrial Classification 28)

The Industry in the United States

Identification

The chemicals and allied products industry (SIC 28) in the United States consists of more than 12,000 establishments engaged in the processing or manufacture of basic inorganic and organic chemicals, plastics materials, synthetic resins, synthetic rubber, synthetic and other man-made fibers, medicinal chemicals, pharmaceutical products, soap and other detergents, cleaning and sanitation preparations, cosmetics and other toilet preparations, paints, varnishes, lacquers, enamels, inorganic color pigments, gum and wood chemicals, fertilizers and other agricultural chemicals, and miscellaneous chemical products such as glue and gelatine, explosives, printing ink, and carbon black.

Composition

More than half of the almost one million workers in the nation's chemical industry are concentrated in basic chemicals and in the manufacture of plastics materials and synthetic resins and fibers. Another 25% of the total employment is engaged in the manufacture of drugs and cleaning and toilet goods. Establishments producing agricultural chemicals and gum and wood chemicals employ only slightly more than 6% of the industry's total work force.

Growth Pattern

Growth is one of the most significant characteristics of the chemical industry. Between 1958 and 1963, the chemical industry recorded an annual growth rate in sales of 6.5%, compared with a 4.9% sales increase for all manufacturing industries. Sales of chemicals and allied products in 1964 were 11.2% higher than in 1963, compared with a 6.7% gain in total industrial production. While industrial production advanced 8% in 1965, the chemical industry recorded a 10.4% year-to-year gain in sales (1). This growth pattern has continued since 1965.

Technological Development

In general, the chemical industry is highly sophisticated in both production techniques and market development, relying heavily on research and

development in the reduction of production costs, the development of new products, and the discovery of new raw materials sources. More than $1 billion annually, equal to about 3.5% of the value of total shipments, has been invested in chemical research and development in recent years (2). This represents the largest investment in research and development of all industry groups, except those that involve greater federal assistance, such as the aircraft and missile industry and the electrical equipment and communications trade.

Outlook

Outlook for the chemicals and allied products industry as a whole is extremely bright. Major problems are those related to the expansion and modernization of plant and equipment to supply rapidly growing and changing markets. Technological innovations are expected to increase output per worker significantly, production should increase at a much faster rate than output per worker, and the widespread application of increasingly complex production processes requiring extensive instrumentation is expected to increase requirements for scientists, engineers, and technicians. Advanced technology should be particularly significant in establishments producing industrial chemicals, petrochemicals, and plastics and other synthetics. Technological innovations that are expected to be used extensively throughout the chemical industry include television monitoring of production processes, radioactive chemical processing, and electronic sensing instruments that replace mechanical testing and measuring devices (3).

The Industry in Georgia

Composition

The composition of the chemicals and allied products industry in Georgia bears little resemblance to the makeup of the overall chemical industry in the United States. While most of the industry segments are represented in the state, Georgia's chemical industry traditionally has been concentrated in the smaller, less technically oriented segments of the industry. Manufacturers and processors of agricultural chemicals and gum and wood chemicals, for example, employ almost 40% of the chemical workers in Georgia and account for about the same percentage of the total number of chemical plants. Nationally, employment in these groups is only slightly more than 6% of the industry's total employment.

The effect of this dissimilar composition of the chemical industry in Georgia is reflected in data from the 1963 U. S. Census of Manufactures. In that year, the average annual wage per employee in the chemical industry in Georgia was $1,435 less than the national average for the industry, and value added per employee was $3,535 less. As late as 1966, according to Bureau of Labor Statistics information, average weekly earnings of chemical workers in Georgia were $99.36, representing only 79.2% of the average weekly earnings of employees in the chemical industry nationwide.

Location

An analysis of listings in the 1966 Georgia Manufacturing Directory shows that chemical establishments are located in 88 of Georgia's 159 counties. Employment is concentrated in certain population centers, however. Chemical firms in the Atlanta area provide the greatest number of jobs, followed by Savannah (Chatham County), Rome (Floyd County), Brunswick (Glynn County), and Augusta (Richmond County).

Growth Pattern

Growth of Georgia's chemical industry has been relatively slow in the past. Between the census years of 1958 and 1963, for example, the number of chemical plants reported in the state increased by only seven, and employment increased by less than 13%. Employment in the chemical industry increased from 2.8% of Georgia's total manufacturing employment in 1956 to 3.0% in 1966, and Georgia's proportion of total chemical industry employment in the United States moved slightly from 1.2% to 1.3% during the same period.

Trends

Recent developments indicate a trend in Georgia toward a more rapid expansion of the chemical industry and a change in the composition of the industry which eventually will lead to an industry mix that is more nearly consistent with the national pattern. In January 1967, the Georgia Department of Industry and Trade reported that 13 new chemical firms had been announced for the state in 1966, representing a total capital investment estimated at more than $100 million. Products of these new manufacturing operations include polypropylene and other synthetic fibers, sulfuric acid and other industrial chemicals, synthetic rubber, paints, cosmetics, and printing ink. This estimate for new

capital investment in the chemical industry more than trebled that reported for any other industry group in the state.

The recent overall growth of Georgia's chemical industry and particularly the trend toward larger, more sophisticated manufacturing operations can be attributed primarily to two factors. First, repeal in 1963 of Georgia's 3% sales and use tax on production equipment going into manufacturing plants provided a direct incentive for high-investment industrial growth. For example, synthetic fiber plants, which previously had located in the states surrounding Georgia, have accounted for most of the chemical industry's capital investment in Georgia in the past two years.

The second factor is related to a new pattern in plant location which has developed in the chemical industry in recent years. While raw materials seemed to be the dominant factor in locating chemical plants in the past, more emphasis is now being placed on the significance of maturing regional markets. In the case of formulated chemical products, the trend has been toward constructing regional branch plants to supply the Southeast's traditional industrial markets (the textile and pulp and paper industries) and agriculture and to save on distribution costs to growing consumer markets.

Industry Problems and Needs

Basis of Analysis

The following analysis of the problems and needs of the chemicals and allied products industry in Georgia is based on personal interviews with managers and operators of 63 chemical plants in the state, the responses of representatives of 66 chemical firms to a mail survey of problems and needs, and the experience of Industrial Development Division staff members in working with Georgia business and industry for more than 11 years.

Nontechnical Problems and Needs

Many of the problems of Georgia's chemical industry are nontechnical and are unrelated to the nature of the industry itself. Most firms, particularly the smaller ones, have difficulty in attracting and retaining employees who are, in the judgment of management, both willing and able to work diligently and productively. Only in the larger and more sophisticated firms is this

problem related to a shortage of applicants with technical experience in the chemical industry. Other nontechnical problems and needs which are prevalent in but not confined to the chemical industry include the need for additional capital, problems in identifying and controlling costs, the need for market information, competition from larger firms, problems in sales promotion and marketing methods, and a variety of problems relating to recruiting, selecting, and developing manpower.

Technical Problems and Needs

Because of the diversity of the chemical industry, specific technical problems and needs apply to individual firms or industry segments rather than to the industry as a whole.

Industrial Chemicals. Manufacturers of industrial inorganic and organic chemicals generally are interested in new technological developments which may be applied in improving quality control techniques, creating new products, and designing more durable process equipment. Individual firms within this segment of the chemical industry cite the need for technical information and service in such areas as materials handling, welding and cutting, clarification of raw materials, and techniques of blending component chemicals.

Plastics and Synthetics. Producers of plastics materials and synthetic resins and fibers -- a growing but not yet major segment of Georgia's chemical industry -- are generally large enough to maintain technical staffs which are capable of keeping abreast of developments and changes in technology. Areas of interest indicated by smaller firms in this segment of the industry include market development, diversification, developments in new soft plastics, the availability of raw materials, and the general field of research and development.

Drugs. The drug segment of the chemical industry in Georgia is not sufficiently large to present a common pattern of problems and needs. New product development, safety procedures, inventory control, and marketing are areas in which individual firms indicate that technical information and assistance would be useful.

Cleaning and Toilet Preparations. Since manufacturers of soap, detergents, cosmetics, and cleaning and toilet preparations produce primarily for the consumer market, many of the problems and needs of this segment of the industry are

related to sales promotion, market development, distribution channels, and new product development. More technical problems which are common to two or more firms include the disposal of chemical wastes, the design of production equipment, and quality control.

Paints and Allied Products. Sales and distribution problems in the paints and allied products segment of the chemical industry are somewhat similar to those of producers of soap, detergents, cosmetics, and cleaning and toilet preparations. Common technical problems in this segment of the industry are the improvement of existing products, color matching and control, and the design of special production and packaging equipment. Specific areas of technical interest of individual firms include information on the effect of radiation on paint and the electro-deposition of paint on metal surfaces.

Gum and Wood Chemicals. A serious problem exists in the gum naval stores portion of the gum and wood chemicals segment of Georgia's chemical industry. During the past 25 years, nationwide employment in gum naval stores has dropped from approximately 30,000 to less than 10,000 (including workers engaged in gathering, warehousing, and processing on the farm, which are not classified as part of the chemical industry). The economic consequences of the decline in gum naval stores is sharply focused in south Georgia, where about 90% of the nation's gum producers are located. Failure of the gum naval stores industry group to compete successfully with other naval stores producers can be attributed principally to problems related to the nature of the industry group itself. Characterized by numerous small producers scattered over a relatively wide area, the industry group as a whole apparently has not made the most efficient use of labor, has not maintained uniform standards of product quality, and has not taken full advantage of modern methods of production and marketing. Research relating to more efficient production and expanded market opportunities is essential to the reversal of the decline in the gum naval stores portion of the gum and wood chemicals segment of the chemical industry.

Agricultural Chemicals. Producers of agricultural chemicals, principally fertilizer, constitute the largest segment of Georgia's chemical industry. This segment consists of many small operators engaged in mixing and blending fertilizers, with some larger operations producing fertilizers from basic raw materials. Some problems and needs are common to both groups: the need for the development of more corrosion-resistant equipment to reduce maintenance costs,

the need for diversification due to the seasonal nature of the business, and the problem of in-plant air pollution and dust control. A continuing problem cited by many small, independent blenders is the competition with the modern equipment, laboratories, and technical know-how of the larger manufacturers and cooperatives. The development of new raw materials sources apparently is the most pressing problem of the larger manufacturers.

Miscellaneous Chemical Products. Firms interviewed in the miscellaneous chemical products segment of the chemical industry included manufacturers of fire retardant chemicals, chemical specialties in maintenance products, water-treating chemicals, printing ink, and solid rocket fuels. Because of the heterogeneity of this group, it is not possible to identify common problems. Areas of interest of individual firms include new developments in nitrocellulose chemistry, the development of new water-treating techniques, and information on resins, solvents, oils, and pigments.

Conclusions and Recommendations

1. Although the chemicals and allied products industry in Georgia is heavily concentrated in agricultural chemicals, it encompasses a broad range of products, including chlorine, caustic soda, industrial gases, dyes and organic pigments, titanium dioxide, caprolactam chemicals, synthetic resins and fibers, biological products, pharmaceutical products, soaps and detergents, cleaning and sanitation preparations, emulsifiers, cosmetics and toilet preparations, paints and related products, gum and wood chemicals, sizes, adhesives, glue, printing ink, bleach, and water-treating chemicals. Because of the diversity and general dissimilarity of this product range, few problems of a technical nature are common to the chemical industry as a whole. It is concluded, therefore, that it would not be feasible to design a special part of the State Technical Services program especially for the broad chemical industry group.

2. Two segments of the state's chemical industry are sufficiently large, homogeneous, and problem-beset to warrant special consideration under the State Technical Services program:

a. Producers and blenders of agricultural fertilizers, although geographically dispersed throughout the state, have a common bond of problems, principally those related to equipment corrosion and in-plant dust control,

which might lend themselves to solution on a group rather than on an individual firm basis.

b. Processors of gum rosin, although representing a relatively minor segment of the total gum naval stores industry group, are nonetheless critically concerned with the sharp decline in demand for gum naval stores. Solution to the problems of quality control, production methods, and the development of new markets will require some new and specialized research. However, it is possible that the application of the results of previous research and the transfer of existing technology could contribute to the alleviation of some of these problems.

3. Within the next five years, the chemical industry in Georgia is expected to expand significantly, particularly in the direction of large, high-capital-investment plants such as those producing synthetic fibers. Operations of this type generally are receptive to new technological developments and are capable of evaluating and applying innovations in the fields of management, engineering, and science. This does not mean, however, that these new plants will generate an appreciable demand on Georgia's State Technical Services program. In most cases, these new plants are branch operations of major national companies which maintain extensive research and development facilities to serve the technical information and service needs of all their operations.

4. With the exception of those industry segments mentioned above, it is concluded that the chemicals and allied products industry in Georgia can best be served on an individual firm basis as part of a general industrial extension service under Georgia's State Technical Services program.

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RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS
(Standard Industrial Classification 30)

The Industry in the United States

Identification

The U. S. rubber and miscellaneous plastics products industry (SIC 30) employed 434,000 persons in 1964 (2). It includes three main subgroups: the tire and inner tube industry, which employs about 23% of the total; other rubber products (rubber footwear, reclaimed rubber, and fabricated rubber products, not elsewhere classified), with 38%; and miscellaneous plastics products, with 39%.

Despite their common classification, these three categories vary considerably in their performance and outlook. Following are summarized trends and developments in each of these three groups.

Tires and Inner Tubes

This has traditionally been one of the large employers in the rubber and miscellaneous plastics products industry. However, despite a steadily increasing volume of shipments (from $2.5 billion in 1958 to $3.7 billion in 1966), employment has remained static or declined slightly as new technology has increased worker productivity. This is a highly concentrated industry; although there are 105 producers in the field, the eight largest companies account for 89% of production. It appears probable that this part of the industry will continue in its present form, with new technology going primarily into productivity improvements or into variations on the basic product, e.g., radial tires.

Rubber Products

In terms of employment, this is a rapidly growing part of the industry, with the number of workers increasing by 18% in the period from 1958 to 1964. Demand has been strong for such items as footwear, toys, cable coatings, drug and medical sundries, and foam rubber. Production of a large number of diverse items and relatively low-volume production per product have tended to keep labor content high, partially accounting for the increasing employment. Technology probably plays a greater role in new product development than in production.

Miscellaneous Plastics Products

This is a very diverse part of the industry and includes a wide variety of products for construction, transportation, appliances, packaging, general industrial application, and consumer uses. The growth in this sector is evidenced by an increase in employment of 69% in the 1958-1964 period. As in the case of rubber products, an extremely large number of products are manufactured, but these may be produced in relatively low quantity. This part of the industry is extremely technology-conscious, and new products and, to a lesser extent, processes are frequently introduced. The wider applications made possible through new plastic resins and the growing acceptance of plastics products in such uses as construction and automobiles indicate that this will continue to be an expanding field.

The Industry in Georgia

Size and Location

The rubber and miscellaneous plastics products industry in Georgia is not large at the present. Approximately 3,400 people are employed in 84 plants in 28 counties. Rubber products account for 70% of this employment total (1). There are two areas of local concentration -- the Fulton-DeKalb area, with 34 plants, and Whitfield County, with 10 plants. The latter includes primarily latexing plants for the Dalton carpet industry. Plant size tends to be small, with an average employment of only 40. The larger plants in the state have employment in the 300-350 range.

Composition

The industry in Georgia is quite diverse and is made up of a number of segments which are unrelated by common interests. The fabricators of rubber products account for 70% of total employment. This group includes four manufacturers of rubber footwear, processors of tread rubber and other tire repairing materials, appliers of latex rug backing, rubber molders, and makers of foam rubber.

Fabricators of plastics products in Georgia produce a wide variety of items, including laminated decorative panels, construction materials, packaging materials, toys, sporting goods, signs, household items, cups, and insulation.

The tire and inner tube segment of the industry was not represented at all in Georgia until 1967 when the Firestone Company announced it would build a $53 million tire plant at Albany.

Significant Trends

The rubber and miscellaneous plastics products industry has increased rapidly in employment in recent years although total employment is low compared to the state's major manufacturing industries. During the period from 1958 to 1966, the work force increased from slightly more than 1,000 to almost 3,500.

Continued growth is expected among fabricators of rubber goods and producers of plastics products, primarily for two reasons: (1) growing local and regional markets which can be served from Georgia locations, and (2) wider use of plastics articles and parts attributable to new materials and increasing public acceptance of plastics.

Value added by manufacture per employee in 1963 was $10,640, or 95% of the U. S. average. The same figure, excluding wages, was $6,742, or 122% of the U. S. average, indicating higher productivity per dollar of wages paid in Georgia. Average weekly earnings in 1966 for this industry have been estimated at $93.85, or about 6% higher than the state average for manufacturing.

Industry Problems and Needs

This analysis of the problems and needs is based upon work done directly with some of the companies in this group under Industrial Development Division's technical and management assistance programs as well as a survey of business needs to which nine companies in this category replied.

A characteristic of this industry in Georgia is its diversity and lack of common interests. Segments of this group frequently feel themselves more a part of some other industry which they serve rather than of SIC 30. The nine firms replying to the survey cited 17 different problems and needs, only five of which were mentioned more than once. Fourteen of the 17 were in the area of general management rather than technology. However, the need which received the most mentions (four) was research and development.

On the basis of these and other observations it appears that the SIC 30 industry category, despite its many dissimilar interests, does have a common

need for general management assistance. A secondary need apparently exists for new technology, particularly as it applies to new product development.

Conclusions and Recommendations

1. The rubber and miscellaneous plastics products industry in Georgia is small, but rapidly growing; if it follows the national industry outlook, it should continue to grow. Expansion of this industry, particularly that part producing plastics, should be encouraged in the state. It is a higher-wage, higher-value-added segment than the average Georgia manufacturing industry. It is also more directly concerned with new technology than most industries because of its orientation toward product innovation.

2. The most obvious need of the industry at present is for general management assistance of the type which could be provided through an industrial extension program.

3. The industry also has need of service of a technical nature, but the diverse nature of technical interests and small size of the industry would make it difficult to prepare a well-defined assistance program for this group. For the present, such needs probably can be handled through industrial extension, but as the industry grows, consideration should be given to programs which could focus on, and encourage, this particular industry.

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PRIMARY METAL INDUSTRIES
(Standard Industrial Classification 33)

Background of the Industry

Identification

The primary metal industries (SIC 33) comprise seven industry groups: (1) blast furnaces, steel works, and rolling and finishing mills; (2) iron and steel foundries; (3) primary smelting and refining of nonferrous metals; (4) secondary smelting and refining of nonferrous metals; (5) rolling, drawing, and extruding of nonferrous metals; (6) nonferrous foundries; and (7) miscellaneous primary metal products (including both ferrous and nonferrous forgings).

Employment Trends

These industries employed about 1.5% of the manufacturing workers in Georgia in 1965, as compared with 7.2% in the United States as a whole. However, although this sector has barely kept pace with the growth in total manufacturing employment nationally, employment in the primary metal industries has grown more than twice as rapidly as that in all manufacturing in Georgia, registering a 56.4% increase between 1958 and 1965 compared with 25.3% for total manufacturing employment. In fact, Georgia's proportion of U. S. primary metal employment has been rising rather steadily over the past 20 years, increasing from 0.3% of the U. S. (3,900 workers) in 1947 to 0.5% of the nation (6,600 workers) in 1966 (7).

Based on a U. S. Department of Labor nationwide forecast of 1,290,000 employees in the primary metal industries by 1975, if Georgia retains its 1966 proportion (0.5%) of the U. S. total in 1975, its employment will drop to 6,450. If its share of U. S. primary metal employment increases in accordance with the 1947-1966 trend, by 1975 its total will be 7,200 workers (0.56% of the U. S.).

Location

The 6,600 persons currently employed in the industry work for 66 companies scattered over 28 counties. All but 1,000 of these are concentrated in eight counties, with 2,600 workers (40% of the total) in Fulton and DeKalb counties alone. Nearby Carroll and Coweta counties have approximately 1,000 workers

each. The industry is primarily one of small establishments, with nearly 80% of the plants employing less than 50 workers each.

Composition

Georgia is more heavily weighted toward nonferrous operations than is the nation as a whole; the Georgia breakdown is roughly 56% ferrous and 44% nonferrous, as compared with 70% and 30%, respectively, for the U. S. Most of the state's nonferrous work is in the rolling, drawing, and extruding category, which leads all groups within the primary metal industries with about 38% of the total. Steel works and rolling and finishing mills follow with nearly 29%, and iron and steel foundries are third with approximately 26%.

According to the 1966 Georgia Manufacturing Directory, eight companies make basic steel shapes, including rolled steel, wire, nails, pipe, and tubing; the largest of these is the Atlantic Steel Company, which employs 90% of the workers in this category and a quarter of those in the entire industry group. Of the 24 establishments which produce gray iron and/or steel castings, the largest with these items as their principal products are at Columbus (270 employees), Atlanta (500), Macon (200), and Toccoa (140). Most of them produce other items as well. Nineteen plants make nonferrous castings of aluminum, bronze, brass, copper, magnesium, and zinc; of these, only the West Point Foundry and Machine Company, which produces nonferrous castings as a sideline, has over 100 employees. There is no primary smelting and refining of nonferrous metals, but three small companies perform secondary smelting operations. Of the 12 companies in the rolling, drawing, and extruding of nonferrous metals category, two have approximately 1,000 employees each: The William L. Bonnell Company in Newnan (aluminum extruded shapes) and Southwire Company (wire and cable products). Very minor aspects of the primary metal industry in Georgia are iron and steel forgings and miscellaneous metal, which are produced by three companies each.

Wage and Output Patterns

The average annual wage per employee in Georgia's primary metals group has risen from $4,231 in 1958 to $5,973 in 1965, a 41% increase in seven years. Georgia's proportion of the national average wage in the industry also has been increasing; it was 73.5% of the national average in 1958, 75.3% in 1963, and 80.8% in 1965. In addition, the value added by manufacture of these Georgia

plants nearly quadrupled in the 1958-1965 period; the total was $59.4 million in 1965, as compared with only $16.2 million in 1958 (3, 4).

Outlook for Georgia

Although primary metals still is one of the smallest manufacturing categories in the state, prospects for continued rapid growth appear bright. At least five new plants and five expansions have been announced in the last two years. Important new plants include a multimillion-dollar foundry at Statesboro that will employ 325 persons initially and 900 ultimately and an operation to make fine film-insulated magnet wire at Trenton whose starting employment of 55 workers is expected to rise to 225 in five years. In the past few months, Atlantic Steel has revealed plans to add a $7.2 million rod mill, and Southwire has announced a $5 million expansion that will result in 400 additional jobs.

National Technological Trends

National trends that may affect Georgia's primary metal industries to some extent in the future include the following:

Production is rising five to seven times more rapidly than employment, due principally to continuing introduction of laborsaving technological innovations and organizational improvements. The introduction of new and improved processes, stepped-up modernization and replacement of equipment, and increased use of automation all have contributed to the growth in output per employee (6).

These technological changes have received added impetus from the national labor shortage in this industry, which is especially acute for ferrous foundries and will be for the foreseeable future. The lack of skilled labor has made on-the-job training almost a necessity. Although increased mechanization reduces the demand for certain categories of skilled workers, in general the growing emphasis on improved mechanization, technology, and quality control increases the demand for more sophisticated employees, such as engineers, metallurgists, technicians, and maintenance personnel for the more complicated new machinery (5).

Employment trends will differ widely for the ferrous and nonferrous segments because of differences in demand levels and the impact of technological developments. Little growth is expected in iron and steel employment, but manpower needs in nonferrous foundries will increase rapidly because of a

significant rise in the demand for nonferrous castings (particularly aluminum) (6). Aluminum is being used increasingly in a broad range of new products and is making inroads upon many traditional markets for steel, plastics, wood, glass, and copper, such as in construction outlets, in pipe, transportation equipment, some consumer durables, electric power transmission lines, and containers and packaging (8).

The foundry industry in general, which historically has consisted of many small operations, has been undergoing a revolution in the last 20 years, with the number of gray and ductile iron foundries declining by 50%. The trend is toward fewer but larger, more mechanized foundries capable of utilizing more sophisticated foundry technology. Another trend is toward specialization in types of castings, thus reducing costs and making casting more competitive with other production techniques (1). "Changing technologies in other industries may reduce the market for some castings. For example, the growing use of continuous casting in steel production, which eliminates ingot molds, will affect adversely the market for this gray iron foundry product." However, advances in foundry metallurgy are enabling foundries to take over some of the market for many metal parts formerly produced by competitive processes such as forging, welding, and stamping; in addition, the casting process is being used more and more for manufacturing small, intricate parts and shaping hard-to-machine alloys used in aerospace applications (8).

In the area of nonferrous diecastings, larger machines and more automatic control are the rule. The newly developed Acurad process, which produces substantially improved aluminum diecastings, is expected to spread as fast as manufacturers can alter present diecasting machines (1). To meet the competition from plastics, some diecasters are diversifying into injection molding of plastics or installing equipment that plates plastics. Another trend is toward integration, adding secondary operations like machining, plating, finishing, and even assembly in order to gain more control over quality and trim costs (2).

Industry Problems and Needs

Basis of Analysis

The following analysis of the problems and needs of the primary metal industries in Georgia is based on personal interviews with management of 20 establishments in the state, responses of eight companies to a mail survey, and the

experience of Industrial Development Division staff members in working with Georgia business and industry for more than 11 years.

Nontechnical Problems and Needs

Various problems relating to labor, as well as sales and markets, lead the list. Specifics include how to recruit and keep good and dependable labor, the high cost of labor, management-employee relations, and the scarcity of good supervisory personnel. (Employee training is discussed under technical problems.) In the area of sales and markets, comments ranged from simple requests for information on distribution channels and markets to indication of need for assistance in sales promotion techniques. Other problems include accounting and cost control and the need for more capital.

Technical Problems and Needs

Technological Information. Much interest was expressed in information on new methods and materials, particularly in regard to modernizing production processes. Subjects included methods of coating metal (galvanizing and plastics), new technology in the tubing field, and information on heat treating of both ferrous and nonferrous metals. Foundries were interested in information on molded materials and methods and core materials and methods, new developments in shell molding, and data on the quality characteristics of phenolic resin bonded core sand. An aluminum extruder expressed an interest in trying out new alloys and finishes.

Most of the Georgia establishments in Major Group 33 are too small to utilize the sophisticated technologies and complex equipment available today. However, many can benefit from simple assistance in the use of basic technology. Actually, most of the foundries in the state are too small to handle the varieties of metal necessary to survive in today's competitive market.

Diversification and New Products. Several firms indicated a need or desire to diversify into new product lines. A particular interest was expressed in new products which can be made with foundry processes.

Trained Manpower. The acute shortage of skilled workers is an ever-present problem, particularly for small concerns, which do not have as much to offer in regard to wages and fringe benefits. On-the-job training is widely practiced

and is about the only approach used to alleviate the problem. Some companies feel that they can benefit from laborsaving devices to increase productivity.

Other Production Problems. Many companies realize that improvements are necessary in plant layout, production scheduling, inventory control, and just general plant modernization. Problems relating to air and water pollution and water supply also were mentioned. Several firms felt that subcontracting services were inadequate, and although not specifically mentioned, the available testing and consulting services in Georgia appear to be too small in size and too limited in scope to meet the needs of a statewide industry that is rapidly growing in size and complexity.

A need mentioned by only one company, but which is an obvious one, is better communication between individual segments of the various metalworking industries for mutual benefit. The component parts of metalworking, including the whole range of activity from primary metals through machinery, are more dependent upon each other than are those of most other industries. They provide each other with subcontracting work, trained labor, markets, raw materials, supplies, and services; consequently, an awareness of the capabilities, facilities, and services which make up Georgia's existing metalworking base is essential to optimum growth. Unfortunately, very little communication and cooperation exists between metalworking concerns in the state, due largely to the smallness and dispersion of the industry. Many firms which could help each other, either in solving problems or in providing contracts or services, do not know of each other's capabilities or existence. Small companies do not bid on complete contracting jobs because their facilities are limited, and few realize the advantages of pooling their resources for mutual gain (collaboration of a foundry and a fabricator or machine shop, for example).

Conclusions and Recommendations

1. A possible project for the Georgia State Technical Services program would be to investigate and suggest ways of overcoming the communications gap between the component parts of the industry groups involved in metalworking. A start in this direction was made a year ago by the Industrial Development Division with the publication of its Directory of Job Shop Capabilities in Georgia, 1966. However, a comprehensive analysis of the state's metalworking complex and related service industries is needed to facilitate optimum growth

of metalworking employment in Georgia, which badly needs to gain its share of the higher-paying jobs which this industry has to offer to balance with the preponderance of the traditional low-wage industrial jobs.

2. Since many firms in other metalworking major groups, such as fabricated metal products and nonelectrical machinery, have indicated that Georgia's foundries, particularly ferrous, are deficient in volume and size capability and in quality of castings produced, a concerted effort might be made to improve the situation. Many firms are not aware of all the sources of castings available to them in the state, especially those plants which run a foundry as a subsidiary operation. A useful service would be a clearinghouse that would make available lists of plants with open casting capacity and those needing to have this work done, along with particular types of castings required. A program of group assistance to the smaller foundries in the state, suggesting ways in which they could modernize facilities and improve the quality of their castings, is a possiblity for the Georgia State Technical Services program.

If Georgia follows the national trend, growth in nonferrous foundry activity (particularly aluminum castings) should be especially marked in the next few years. This is highly likely since Georgia already is heavily weighted toward rolling, drawing, and extruding of nonferrous metals. Consequently, some problems related to the nonferrous group alone may arise that may lend themselves to technical services.

3. In general, since the primary metal industry is so small and so few companies manufacture each type of product, most of this industry's technological needs can best be filled by responding to individual requests as part of a broad industrial extension service under Georgia's State Technical Services program. The small plants, in particular, need management assistance as well.

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FABRICATED METAL PRODUCTS
(Standard Industrial Classification 34)

Background of the Industry

Identification

The fabricated metal products industry (SIC 34) includes establishments fabricating all ferrous and nonferrous products except ordnance, machinery, transportation equipment, jewelry and silverware, and professional, scientific and controlling instruments, watches and clocks; these items are classified under separate codes. Major Group 34 consists of nine subgroups: (1) metal cans; (2) cutlery, hand tools, and general hardware; (3) heating apparatus (except electric) and plumbing fixtures; (4) fabricated structural metal products; (5) screw machine products, and bolts, nuts, screws, rivets and washers; (6) metal stampings; (7) coating, engraving, and allied services; (8) miscellaneous fabricated wire products; and (9) miscellaneous fabricated metal products. Establishments in subgroups (5), (6), and (7) generally operate on a job or order basis.

Employment Trends

The fabricated metal industry employed about 3% of the manufacturing workers in Georgia in 1965, as compared with 7% in the nation. It was the fastest-growing manufacturing segment in the state between 1958 and 1965, more than doubling its employment total, compared with a 25% increase for all manufacturing. The corresponding increases nationally were 17% and 12.8%, respectively. Georgia's proportion of U.S. fabricated metal employment has been increasing more or less constantly over the past 20 years, rising from 0.36% of the U.S. (3,600 workers) in 1947 to 1.05% of the nation (14,200 workers) in 1966 (8). The state's biggest employment gains were in 1963 and 1966, with about 2,000 workers added in each year.

Based on a U.S. Department of Labor nationwide forecast of 1,460,000 employees in the fabricated metal products industry by 1975, if Georgia retains its 1966 proportion (1.05%) of the U.S. total in 1975, its employment will be 15,300. If its share of U.S. fabricated metal jobs increases in accordance with the 1947-1966 trend, its employment will be 1.23% of the U.S. (18,000 workers) in 1975.

Location

Georgia's fabricated metal group comprises 417 establishments located in 67 counties scattered throughout the state, with the heaviest concentration in the northwestern section. Two-thirds of the employment, however, is concentrated in only 11 counties. Fulton and DeKalb counties alone account for one-third of the fabricated metal workers in the state and nearly 40% of the plants. One-half of the plants in the state have less than five employees each, and only one plant has 1,000 or more workers. More than half of the plants with over 100 employees are branches of out-of-state concerns.

Composition

Analysis of the 1966 Georgia Manufacturing Directory reveals that in Georgia nearly 60% of employment in the industry is in fabricated structural metal products, as opposed to 30% in the United States as a whole. Metal stampings, the second largest category, has one-sixth of the workers in both Georgia and the U.S. The remainder of the employment is distributed over the other seven subgroups.

Fabricated structural metal products are made by 309 companies spread over 55 counties; one-third of these plants and workers are found in the Fulton-DeKalb area, however. Most of the companies have less than 100 employees, and only six have 200 or more workers engaged in this specific line, although several plants which also produce items in other categories have total employment in this range. Their products include fabricated structural steel; metal doors, windows, screens, and trim; fabricated plate work (including boilers, tanks, and nuclear reactors); sheet metal work; and architectural and miscellaneous metal work. The largest single plant (Amarlite Division of Anaconda Aluminum Company) has 650 persons engaged in producing store fronts, doors, and curtain walls. The miscellaneous grouping includes seven firms that produce pre-engineered metal buildings.

Of the 33 companies which produce metal stampings, 26 also do other manufacturing. The largest company in Major Group 34, however, does nothing but stamping -- Metal Products, Inc., Division of Thompson Industries, Inc., which produces trim moldings and has an employment of 1,100. The same is true of the next largest firm in this subgroup, Enterprise Aluminum Company, whose 516 workers produce aluminum cookware. These two plants account for over 60% of the workers engaged in this specialty.

The other seven categories include, in descending order of estimated employment, six companies which make metal cans; 32 plants producing miscellaneous metal products; 28 firms performing coating, plating, anodizing, polishing, engraving, and galvanizing services; 10 operations in the heating and plumbing equipment category; 17 companies making miscellaneous wire products; seven firms engaged in manufacturing cutlery, hand tools, and general hardware; and six plants which turn out screws or screw machine products.

Wage and Output Patterns

The average annual wage per employee in Georgia's fabricated metals group rose from $4,083 in 1958 to $5,158 in 1965, a 26% increase in seven years. However, the state merely kept pace with nationwide increases during this period; Georgia's average wage rose only slightly from 80% of the national average in 1958 to 82% in 1965. Georgia fared much better in terms of output; value added by manufacture increased 131% in the seven-year period, rising from $49 million in 1958 to $113 million in 1965 (5, 6).

Outlook for Georgia

Between 1958 and 1965, employment in Georgia's fabricated metal products industry grew from 1.8% of all manufacturing employment to 3.0% of the total. The industry should continue to be an increasingly important part of Georgia's economy. In the past two years, over 40 new plants and expansions of existing plants have been announced. Most of them were modest in capital outlay and added employment, but they included a $3 million plant to fabricate steel buildings at Cedartown (employing 100 initially and 300 ultimately), an $800,000 custom galvanizing shop started by Atlantic Steel, a $750,000 operation to manufacture corrugated metal pipe at Lawrenceville, an expansion into a $400,000 new facility for a DeKalb County fabricator and erector of structural steel, and nearly a dozen other announcements involving capital investment of over $200,000 each.

National Technological Trends

The big innovation in this industry, and in many other manufacturing fields as well, is the use of numerically controlled (N/C) machine tools, which dramatically increase productivity; tenfold increases have been reported in many cases, and lathes and drills that can expand productivity 100 times or

more are not uncommon (2). Basically, numerical control is a means of automatically controlling machine tool operation by use of punched or magnetic tapes and electronic equipment. N/C tools reduce total labor input and raise output because they operate at much greater speeds and with a much higher degree of accuracy and flexibility than conventional machine tools, they require less tooling labor, and they can be run by labor with lower skill levels (1).

To date, N/C tools have been used predominantly in high-volume production line work, but the technique is particularly suited to the production of a variety of different metal parts in small volume because of the ease of changeover by switching tapes. Depending upon complexity, they cost anywhere from about $10,000 to over $2 million. Since the simple N/C tools are economically feasible for even the small job-shop operations typical of the fabricated metal products industry, the use of them should mushroom in the next few years. In fact, it has been predicted that N/C machines will produce at least 80% of the U.S. output from general-purpose machine tools by 1975 (4).

Beginning with metalcutting functions like contouring and drilling, numerical control has branched out into such other operations as forming, welding, and flame cutting. In addition, there are some operations which have become economically feasible or technologically practical only since the advent of numerical control. One trend is toward multi-purpose machine tools and integration into machining centers. It is not unusual to find small, specialized computers running several machines simultaneously, and operation on a shared-time basis is becoming rather common in major industrial areas (3).

Another laborsaving technique is the use of automatic transfer and conveyor systems, which will grow rapidly in plants producing large quantities of a standardized product. This technique also is useful in production operations such as heat treating, welding, forging, and plating (7).

These developments should reduce the requirements for production and toolroom machinists, machine tool operators, tool and die makers, and materials-handling personnel, while increasing demand for engineers, programmers, and tool maintenance men.

Industry Problems and Needs

Basis of Analysis

The following analysis of problems and needs of the fabricated metal products industry in Georgia is based on 66 personal interviews with owners or managers of Georgia establishments and on replies from 65 firms to a mail survey, as well as judgment gained from the Industrial Development Division's 11 years of experience with industrial problems.

Nontechnical Problems

Several problems were mentioned that are not restricted to the specific characteristics of the fabricated metal products industry, but which are common to a number of businesses. Most frequently named were manpower problems. Many companies find it extremely difficult to find enough adequately trained labor, and some firms even have problems in recruiting, training, and keeping good, dependable unskilled labor. Most plants have to train workers on the job. Other labor-related problems include turnover; the high cost of labor, especially skilled or technical personnel; personnel testing, selection, and placement; labor-management relations; and difficulty in obtaining good supervisory personnel.

Concern with marketing and sales performance was fairly widespread, with the need to find additional outlets most frequently mentioned. Smaller firms, in particular, need help with sales promotion and marketing procedures; a few companies also stressed the need for more market information.

A number of problems that were mentioned involve general business practices; cost control was named most frequently, but inventory control, accounting methods, and organizational planning also were singled out by several firms. Several fabricators of ornamental iron work named getting customers to pay their bills promptly as one of their biggest problems.

Technical Problems and Needs

Such a diversity of products is manufactured by fabricated metal operations in Georgia that, although they have many problems in common, problem emphases can be explained more easily by discussing several classes of producers separately.

Fabricated Structural Metal Products. A total of 89 responses were received from plants making a wide variety of structural metal products. Since over 70% of the establishments and nearly 60% of the employment in Major Group 34 are in this category, there is strong competition in some of the product lines. Diversification and the need to develop new and improved products were mentioned often. Manufacturers of prefabricated buildings were interested specifically in "space-grid" building construction, and an aluminum extruder wanted information on metal and plastic injection molding.

Some dissatisfaction was expressed with local sources of materials and services. Materials purchased from distant sources included glass, industrial fasteners, screen wire, plastic components, lacquer and paint, hardware, motors, and many types of steel. Wide widths of steel are particularly hard to obtain nearby. Firms specifically mentioned desire for Georgia sources of steels, wide flange beams, and oil and gas controls and a source of quality hardware in the South. Most companies which mentioned subcontracting services found their local sources adequate in quality, but several firms stated that there was a need for additional tool and die and heat-treating capacity in their localities. One plant wanted a nearer source of anodizing services.

Many of the comments in reference to the scarcity of quality personnel stressed the more technical occupations: draftsmen, layout men, estimators, engineers. A number of companies mentioned an interest in information on the latest techniques. Some firms were interested in data on strongly competitive materials for construction uses, such as plastics.

Metal Stampings. Producers of metal stampings mentioned problems related to production methods most often, followed by a lack of good local sources for tools and dies and the need for skilled manpower. One firm which purchases lithographed steel from Alabama stated a need for a local source.

Heating Apparatus and Plumbing Fixtures. The big problem here is the rapid obsolescence of products, and much interest was expressed in diversification and modernization of products and processes. However, one manager stated that the shortage of skilled molders limited the opportunities for adding new products. Manufacturers of stoves and heaters found it difficult to obtain materials commonly needed in their trade within the state; one producer ordered some materials from the Midwest, California, England, and Denmark. He also

tried several nearby foundries, but none could produce castings of sufficient quality and within the close tolerance required.

Coating, Engraving, and Allied Services. Of all the industries in the fabricated metals group, plating and anodizing plants require the largest quantity of water per unit of production and discharge the greatest amount of chemical wastes. Some plants do not neutralize solutions before dumping them into sewers or streams. Careful planning will have to be done by many of these firms if they are not to run afoul of recently strengthened anti-pollution laws. Other than this, no significant problems were revealed.

Miscellaneous Metal. The need for development of new products topped the list in this group, also. Other concerns were raw material supply and production methods. One company wanted information on impact extrusions.

Other Products. The only major problem common to the remaining subgroups was the scarcity of skilled labor. The only producer of metal cans interviewed stated that some of the plant's tool and die work was subcontracted in Chicago and New York. A screw machine products manufacturer mentioned diversification and quality control. Cutlery and hardware firms listed the need for improved production techniques (involving grinding and heat treating high-carbon, high-chrome alloys; saw filing, toothing, and setting; metal joining; metal lubrication and rust prevention, etc.) and the need for more broach work capability in the Atlanta area. Miscellaneous wire products manufacturers listed quality control, equipment maintenance, and production methods.

Conclusions and Recommendations

1. Since the fabricated metal industry in Georgia is characterized by small establishments, with one-half of the plants employing less than five workers each, managements of the vast majority of the firms are not equipped to assimilate and use any but the simplest technological improvements. Actually, the primary need of the really small concerns, run by an owner-manager, is simply for general management assistance of a nontechnological nature. The range of products and services offered by this group also is very wide. Consequently, most of the assistance to metal fabricators under the Georgia State Technical Services program will have to be responses to individual requests for information and advice. As the most rapidly growing manufacturing industry in

Georgia, the fabricated metal products group will have particular need for assistance in solving problems related to expansion of existing plants and the establishment of new operations.

2. Some research is needed as to the feasibility of using N/C machine tools in the medium-size and small plants. Georgia producers in the future will have to automate production as much as possible, not only as a partial solution to labor problems, but particularly to be able to compete with other areas in product quality, quantity, and price. The need for truly precision work is increasing every day. Automated tools, currently installed in only a few of the largest plants, often are worth the added investment to the job shop because, in the long run, they make it more efficient and more economical to turn out a variety of items in small lots.

3. The area vocational-technical schools scattered over the state are available to cooperate with firms in training young men in the skills required by neighboring industries. A majority of these schools offer welding courses, and Atlanta Tech also offers a sheet metal course. Managers with staffing problems should be encouraged to contact these schools.

4. Since a number of the firms in the fabricated metal products industry indicated that closer sources of supply were needed for a variety of raw materials and many companies also were interested in diversification, assistance could be provided in both areas by compiling a list of the items needed. Those desired in sufficient quantity by one or more firms then could be suggested to appropriate companies for manufacture as an added product line or even could serve as the impetus for the establishment of new plants. The information could be collected routinely in the course of interviews with plant managers such as those carried out under the current field service program of Georgia Tech under State Technical Services auspices.

5. Assistance also might be provided to plating and anodizing operations in alleviating their waste treatment problems.

6. The need for increased communication and cooperation between the various segments of the metalworking industry, previously mentioned in the analysis of primary metal industries, applies to the fabricated metal products group as well. Some concerted effort should be made to document the capabilities of Georgia's metalworking and related service industries and to find a

practical way of enlarging these firms' awareness of each other's capabilities and needs. By strengthening its existing metalworking complex, the state will increase its attractiveness to outside industry of a more sophisticated nature and thus foster its growth toward a well-balanced industrial economy.

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MACHINERY, EXCEPT ELECTRICAL
(Standard Industrial Classification 35).

Background of the Industry

Identification

The machinery (except electrical) industry (SIC 35) encompasses the manufacture of machinery and equipment other than electrical and transportation equipment. Major components of this industry are nine: (1) engines and turbines; (2) farm machinery and equipment; (3) construction, mining, and materials handling machinery and equipment; (4) metalworking machinery and equipment (including contract tool and die shops); (5) special industry machinery (food products, textile, woodworking, paper, printing, and others); (6) general industrial machinery and equipment; (7) office, computing, and accounting machines; (8) service industry machines; and (9) miscellaneous machinery (including machine jobs, jobbing and repair).

Employment Trends

The machinery (except electrical) industry employed 2.7% of the manufacturing workers in Georgia in 1965, as compared with 9.5% in the United States as a whole. Employment growth in this group exceeded that in all manufacturing only slightly between 1958 and 1965 in Georgia, registering a 32% increase compared with 25% for all manufacturing. The national rate of growth was 25.8% -- twice that of all U. S. manufacturing but less than Georgia's growth in the machinery industry (8).

Over the past 20 years, employment in the nonelectrical machinery industry has fluctuated in Georgia, both in absolute numbers and in proportion of U. S. employment. From 7,500 workers in 1947, Georgia declined to a low of 5,700 two years later and did not rise above the 1947 figure until 1956, when the total reached 8,600. Georgia's employment was 0.55% of the U. S. at both the beginning and the end of the 1947-1956 period. Employment fluctuated slightly in the latter half of the 1950-1960 decade, but did not make any significant gains until the 1960's. Growth has been almost constant since 1960, and employment in the industry reached 12,300 persons (0.66% of the U. S.) in 1966 (8).

Based on a U. S. Department of Labor nationwide forecast of 2,050,000 employees in the nonelectrical machinery industry by 1975, if Georgia retains its

1966 proportion (0.66%) of the U. S. total in 1975, its employment will be 13,500. If its share of U. S. nonelectrical machinery employment increases in keeping with the 1947-1966 trend, Georgia's workers will number 14,600 in 1975 -- 0.71% of the U. S. total.

Location

Nonelectrical machinery is manufactured by 372 companies in 78 Georgia counties. Nearly 36% of the employment and one-third of the plants are in Fulton and DeKalb counties. In fact, for six of the products manufactured in Major Group 35, the Fulton-DeKalb area is the only Georgia source: gantry and bridge cranes, data processing equipment, mechanical power transmission equipment, commercial laundry equipment, industrial vacuum cleaners, and measuring and dispensing pumps. Next in employment rank, but many times smaller, are Muscogee and Stephens counties, with between 500 and 1,000 workers each. At the other end of the scale are Burke and Wilcox counties, each with one two-man shop.

One-half of the plants in the state have less than five employees each. The three largest plants in Georgia which produce machinery as their main line each have between 500 and 1,000 workers, although several establishments which have machinery as a subordinate line have greater overall employment.

Composition (2)

Special Industry Machinery. Georgia's employment profile for Major Group 35 varies considerably from the national pattern. Special industry machinery leads the list with 32% of the total, about half of whom manufacture textile machinery. This is not surprising for one of the leading textile-producing states in the nation. More specifically, one-fourth of the establishments making textile machinery and one-fifth of their employment are at Dalton, the center of the north Georgia tufted carpet industry, which produces over 60% of all American-made tufted carpets. In contrast, employment in special industry machinery manufacturing is only 11.5% of that for the entire two-digit industry in the U. S. as a whole, and textile machinery employment amounts to about one-sixth of the subgroup total.

Georgia plants which make textile machinery and parts, either as their main product or as a sideline, total 52; other establishments making special industry machinery include 17 which turn out food products machinery, 10 producing woodworking machinery, three manufacturing paper industries machinery,

five making printing trades equipment, and 21 producing miscellaneous special industry machinery (e.g., cotton ginning machinery, aircraft maintenance equipment, plastic processing equipment). The largest single plant concentrating its work in the special industry field is at Columbus; its 800 workers produce primarily cotton ginning and textile machinery. Seven more of the 105 firms in this subgroup each have over 100 employees engaged in this work.

General Industrial Machinery. General industrial machinery and equipment are made by 29 firms. These include pumps and pumping equipment, 13 plants; blowers, fans, and filters, five firms; industrial patterns, four shops; mechanical power transmission equipment, three companies; and miscellaneous, four firms. The only large firms specializing in this field are a pump manufacturer at Commerce and a producer of filter items at Augusta. Providing a healthy 15% of total nonelectrical machinery employment in the nation, this category employs only about 7% in Georgia.

Construction, Mining, and Materials Handling Machinery. Construction, mining, and materials handling machinery and equipment are made by approximately 15% of the workers in the nonelectrical machinery industry in both Georgia and the U. S. Of the 35 Georgia plants in this category, seven producing these items as their main line have over 100 employees. They include a 600-employee earth-moving machinery plant at Toccoa, a 200-man elevator factory in Atlanta, and a 300-worker Atlanta plant that produces materials handling equipment.

Metalworking Machinery. Metalworking machinery employment in Georgia is only 9% of the total for Major Group 35, as contrasted with 18% in the United States, which is understandable in view of the relatively small size of the metalworking industry in the state. Seven companies make machine tools for cutting or forming metal. Hydraulic presses are only a minor part of the output of the largest firm listed here (the previously mentioned 800-employee plant at Columbus), but the entire 237-man staff of the next-largest firm (at Cordele) produces hydraulic shears and baling presses.

Forty-two companies manufacture special dies and tools, die sets, jigs, and fixtures. Most of these operations are small or constitute only part of a larger operation. Six other plants also fall into the metalworking machinery subgroup, bringing the total to 55 companies.

Farm Machinery. The proportion of machinery manufacturing workers engaged in producing farm machinery is about 14% in Georgia -- twice the proportion

nationally. They are employed in 59 plants, over one-half of which are small establishments of less than 25 workers. Of the 10 companies in the over-100-employee range, only five manufacture farm machinery exclusively -- Gravely Tractors at Albany, King Plow Company in Atlanta, Lilliston Implement Company near Albany, Southland Manufacturing Company at Cordele, and Rome Plow Company at Cedartown. In addition, Columbus Iron Works (350 employees) has farm implements as its primary product, and McDonough Power Equipment, Inc. (190 workers) is widely known for its power mowers.

Other Machinery. There are 119 establishments doing machine jobbing and repair work in Georgia, over one-half of which also perform other operations. Most are small, but 10 shops have over 50 employees each. Only two large operations, in Atlanta and Macon, do machine shop work as their principal activity. Nevertheless, workers engaged in machine shop activities form 10.5% of the total workers in Georgia's nonelectrical machinery industry. Eleven other companies also do miscellaneous machinery work.

In addition, three small companies make outboard motors, one produces data processing equipment, and three produce office machines. The service industry machine category includes two producers of vending machines, one manufacturer of laundry equipment, one manufacturer of industrial vacuum sweepers, two producers of gasoline pumps, nine makers of refrigeration machinery, and eight manufacturers of miscellaneous equipment (e.g., commercial cooking equipment). Largest of these are Thermo-King Corporation at Louisville, which employs 300 persons in producing truck refrigerators and automobile air conditioners, and The Warren Company, Inc., of Atlanta, whose 561 employees make commercial refrigeration equipment and display shelving.

Wage and Output Patterns

The average annual wage per employee in Georgia's nonelectrical machinery industry increased 31.4% between 1958 and 1965, rising from $4,319 to $5,675. However, since the national average wage increased in a comparable manner, Georgia's wage remained 80% of the national figure. During the same period, value added by manufacture in Georgia plants rose from nearly $67 million to $110 million, a 65% gain compared with an 84% increase nationwide (4, 5).

Outlook for Georgia

The nonelectrical machinery industry in Georgia has grown at only a very slightly faster rate than manufacturing as a whole, in terms of employment, and no acceleration of the pace is foreseen in the near future. However, capital investment in new and expanded plants has totaled a healthy amount in the past two years. Rough estimates compiled from the files of the Industrial Development Division indicate that over $12 million was spent on facilities for nearly 50 new and expanded plants in 1966 and 1967. About half of these projects involved over $200,000 each, including a $2 million replacement plant for Auto-Soler Company of Atlanta (high-speed nailing machinery), a $1.5 million expansion into a new facility at Sasser for Lilliston Implement Company (whose farm equipment is sold internationally), and a new $535,000 plant at Tucker opened by American Chain and Cable Company to manufacture and assemble monorail equipment and conveyor systems. Tool and die and machine shops led the list with 16 projects, and farm machinery followed closely with 14 announcements. Three new and two expanded operations in the materials handling equipment line also were announced, as well as a large new manufacturer of stainless steel restaurant equipment and three plant expansions in the food products machinery area.

National Outlook and Technological Trends

The rapid and sustained growth in demand for most types of nonelectrical machinery in the past eight to ten years has made the shortage of skilled labor in this industry the most acute in all the metalworking industries. This problem has accelerated the adoption of technological advancements which greatly increase per-employee output. Significant developments include more widespread use of numerically controlled (N/C) machine tools and automatic transfer equipment as well as greater reliance on instrumentation and computers to control and improve production and recordkeeping functions (7).

Numerical control of machine tools is a key development in the evolution of machinery. It is a means of automatically controlling machine tool operation by use of electronic devices and changeable tapes. This technique effects substantial reductions in manpower time and skill requirements while significantly increasing volume and quality of output. Of particular importance to this major industry group, in which much "small lot" or "job shop" work is performed, is the technique's adaptability to machining small lots of metal parts and equipment. N/C tools reduce requirements for machinists and machine tool

operators, while increasing demand for engineers, programmers, and technicians. (For more detail, see discussion of N/C tools in analysis of SIC Group 34.)

The use of automatic transfer equipment is growing rapidly in plants manufacturing large volumes of standardized products. Transfer machines automatically move work pieces from station to station and position them for each operation; separate operations are performed at each station. They lessen the need for machine tool operators and materials handling workers.

Production control instruments and computers decrease the importance of inspectors, operators, and some clerical workers, but raise requirements for maintenance and repair technicians.

New metal cutting and forming methods also are having some impact on the metalworking industries (10). Although conventional mechanical cutting tools will be the most economical type for a long time to come, four revolutionary methods of machining should be mentioned: (1) laser beam machining -- use of beams of intense light to machine and weld; (2) electron beam machining -- already used widely in the aerospace and electronics industries for micromachining and microwelding; (3) electrical discharge machining -- using sparks to remove metal by eroding the work material; (4) electrochemical machining -- "deplating" work material from the work. These electrical methods lend themselves to lighter and cheaper tools, and they can machine hard metals as easily as soft ones.

High-energy-rate forming methods are estimated to be capable of forming parts of almost any size and material. They include (1) explosive forming, in which explosives are detonated against sheet-metal blanks, forcing them into shaped dies; (2) electrohydraulic forming, which uses a high-energy electric spark in operations similar to those done by explosive forming but is more easily controlled; (3) electromagnetic forming, in which strong magnetic fields are used to push or pull materials into any desired shape; and (4) pneumatic-mechanical forming, in which the press ram in a special press is accelerated to high velocities by sudden release of high-pressure gas.

In the increasingly mechanized and automated American milieu with its rising levels of population and personal income, it seems obvious that prospects for continued sustained growth of the nonelectrical machinery industry are excellent. Rapid growth will be the rule in the special industry machinery category as a result of increased consumer demand for textiles, apparel, foods,

furniture, paper and paper products, and printed matter, as well as the need for replacement of obsolete equipment (7). A prime example is the textile industry, in which it is estimated that over one-half of the machinery is over 10 years old (3). Textile mills are finding it necessary to automate to overcome their dwindling labor supply, to improve their operating cost-profit margins, and to meet severe competition from imports. In addition, the industry's intensive R & D efforts are paying off in terms of new products that require new machinery to produce them.

The need for service industry machines (such as vending machines and dry cleaning equipment) should continue to grow along with the demand for personal services and conveniences, and the rapid computerization of the business world should keep demand high for office, computing, and accounting machines. Rising construction activity -- buildings, highways, dams -- and the increasing mechanization of materials handling in many industries should keep output in the construction, mining, and materials handling machinery subgroup at a high level (7). In fact, U. S. producers of many leading construction items are producing at a near-capacity level, and lead times for delivery of some equipment are over one year in length (6). Air-conditioning and refrigeration equipment also are finding more widespread uses; particularly important is the increased application of temperature and humidity control measures to manufacturing processes in such fields as textiles, synthetic fibers, printing, electronics, and metalworking (1).

Domestic production of farm machinery more than doubled between 1960 and 1967. This specialty promises to be a real growth industry for the next decade for several reasons: (1) the trend toward larger, more mechanized farms and the need to beat the high cost of farm labor; (2) increased food demand resulting from the worldwide population explosion and the rising standard of living in the United States; and (3) continuing development of new harvesting machinery for specialty crops (6). In addition, two new machinery markets that hold great promise for the future are those for water desalination equipment and industrial air pollution control equipment (3).

The backbone of the nonelectrical machinery industry -- metalworking machinery and equipment -- has excellent potential for future growth, along with pressing current problems. For several years, the industry has had a backlog of orders greater than it could fill even though it has been operating at top

capacity. A large proportion of this high level of orders is due to obsolescence of tools rather than expansion; in 1963, an American Machinist survey revealed that 64% of the metalworking machinery in use was at least 10 years old. In the last few years, American industry has been stimulated to accelerate replacement of obsolete equipment by changes in federal regulations to allow more rapid depreciation of new machinery and equipment and to provide income tax credit for new investment. A temporary suspension of these provisions tempered their effect, however.

In attempting to reduce this order backlog, which averaged 11 months a year ago and eight months last October, with some automated units booked into the latter part of 1969, the industry has been hampered by a shortage of skilled labor and a scarcity of materials, parts, components, and accessory equipment. When operating at or near top capacity, the machine tool industry is forced to rely more heavily on subcontractors, and the availability of subcontractors who are geared to produce to the accuracies required in the machine tool industry is quite limited (6).

The pinch has given foreign machine tool producers a substantial wedge into the domestic market. Imports totaled $117.7 million in 1966, more than twice the 1965 figure and triple the 1964 total, and were over $200 million in 1967. In addition to faster delivery, foreign tools feature lower prices, often amounting to 15% to 25% below U. S. prices; this spread should increase with the effect of the devaluation of the pound and tariff reductions that ultimately will halve U. S. duties on machine tools. Foreign manufacturers recently invaded the N/C tool market as well. The fear is that when domestic deliveries return to normal, part of the U. S. industry's market will have been lost permanently (9).

All of the important technological advancements discussed at the beginning of this section have especial application to the machine tool industry since this is where the machinery that incorporates most of these techniques is made. As automated tools are produced in greater numbers and at lower cost, demand will increase at an accelerated rate and sales for many types of conventional tools will decline. Also, fewer units of N/C tools will have to be sold, since they are more productive than standard tools (3). However, their speed should result in faster wear and shorter replacement intervals.

Industry Problems and Needs

Basis of Analysis

The following analysis of the problems and needs of the nonelectrical machinery industry in Georgia is based on personal interviews with owners and managers of 100 machinery operations in the state, replies of representatives of 75 machinery firms to a mail survey of problems and needs, and the experience of Industrial Development Division staff members in working with Georgia business and industry for over 11 years.

Nontechnical Problems and Needs

The most frequently mentioned problem of nearly every segment of Georgia's nonelectrical machinery industry is the usual complaint of many businesses today -- an inadequate supply of available trained labor. This problem seems especially acute among manufacturers of construction, mining, and materials handling machinery and equipment, producers of special industry machinery, and machine shops. The latter two categories are dominated by small firms. In general, the small firms are the ones which have the most difficulty in recruiting and retaining reliable labor; the custom nature of their work often presents a financial problem as to when and whom to "lay off." Small firms also are most concerned with the high cost of labor. They feel the pinch of competition from large firms for workers (and sales) keenly.

A number of typical management problems cropped up frequently among these small companies. These included lack of sufficient expansion or working capital, cost accounting and cost control problems, and the need for better inventory systems. In the area of sales and markets, quite a few firms mentioned the need for more business. Some specified desire for off-season contracts, which also would help solve their labor retention problems. The really small firms found it difficult to spare time, personnel, and money to mount an effective advertising and sales program. One of the basic problems of the small concerns is that the owner-manager usually is a technically oriented person with little or no management and sales experience or training.

Technical Problems and Needs

Since such a wide variety of products is made in the nonelectrical machinery industry, each segment of the industry has its own characteristics and the relative importance of the major technological problems varies.

Farm Machinery. A major concern is diversification and the development of new or modernized products. Since a number of these firms were established many years ago, they have had to adapt to the manufacture of mechanized equipment and changes in production processes, distribution channels, and markets as well. Several firms implied that their plant layout and production lines were inefficient. Interest was expressed in new welding and fabricating techniques and in heat treatment of metals.

Closer sources of supply are needed. Items purchased from distant sources include castings, some forgings, disk blades, gear boxes, sprockets, universals, tubing, bearings, oil seals, wheels and rims, double torsion springs, metal washers, and heavy metal stampings. One company, however, is actively seeking to sell its foundry capacity on a subcontract basis. A large producer of farm implements reported a big problem with present suppliers of castings because they have insufficient capacity to handle the firm's volume without a lot of lead time. This firm also has to send parts to Illinois for heat treating because it is dissatisfied with quality and prices of the small southern firms.

Special Industry Machinery. Citing the rapid obsolescence of machinery in the industries which they serve, one-fifth of the companies interviewed indicated that the time, facilities, and personnel which they could devote to research and development were inadequate. The skilled engineering staff needed for development work is beyond the financial reach of the small concerns. A shortage of skilled machinists was mentioned, and several Atlanta area firms stated that the cyclical hiring and firing policies of a large manufacturer in the area made the labor market unstable. There was agreement that a definite need exists for more reliable foundry work, and a scarcity of some screw machine parts was mentioned. One manager stated that he thought there was room for additional paper machinery manufacturing capacity in the area. This group is very interested in new technology. For example, a 27-employee firm at Vidalia wants information on N/C tool developments. A 165-worker Atlanta plant is interested in electrical discharge machining or die making, chemical milling for burr removal and polishing, and ultrasonic cleaning. Other interests are new developments in automatic welding and metal fabrication. Textile machinery manufacturers constantly try to keep up with advances in textile fiber processing.

Machine Shops. As so aptly put by one respondent, the universal problem for really small (under 25 employees) welding and machine shops is getting and

keeping good, reliable welders, machinists, and helpers. He voiced another often-echoed complaint: young men these days are not interested in the long apprenticeship required for skilled jobs. Since about 90% of Georgia's machine shops fall in this size category, these labor problems overshadow all others. In addition to recruiting and training difficulties, these "job shops" are troubled with uneven work loads, resulting in problems related to work scheduling, worker efficiency, and having to terminate employment of men they had spent considerable time in training. Some in this group also resent the unstable personnel policies of large manufacturers offering higher wages in the Atlanta area. They hire men "laid off" by these large firms, but the workers always return to the big plants when they start rehiring.

In the area of materials and services, some need was indicated for a better supply of precision forgings and for suppliers of ceramic coatings. Most of the companies are too small to find advanced technological information useful. Typical is one owner who, when asked to name his greatest problem, wrote "understanding and using the proper machinery and engineering advice." The major problem of another proprietor was the ability to turn out a uniform weld. He did not know where to go for help, nor where to get information on preheating and methods of welding cast iron.

Construction, Mining, and Materials Handling Machinery and Equipment. Diversification and new products form an important concern for this group. Manpower problems include "the high cost of technical talent," "getting qualified people with engineering training for estimating and drafting," and the necessity for in-plant training of mechanics. A maker of industrial trucks and related items desires closer sources of pig iron, steel, ball and roller bearings, crude rubber, and polyester resin. Another company wants more convenient sources of bolts and electrical controls. A third comment concerned the relatively high costs of heat treating and plating in the area.

General Industrial Machinery. Some dissatisfaction was expressed with local sources of some supplies and services. A gear manufacturer felt that the price of blanks was too high in the area. A definite need was expressed for additional screw and nut manufacturing capability. Pipe and fittings are shipped from Ohio to a local manufacturer of sprinkler systems. Some personnel recruiting and training problems were mentioned, as well as plant layout and product engineering and designing needs.

Metalworking Machinery. No problem emphases could be ascertained from analysis of the replies of metalworking machinery manufacturers, although a shortage of first-class tool and die makers was mentioned. This is as much a reflection of a national problem as a local one. Some insight into the shortcomings of Georgia tool and die shops can be gained from analysis of comments of users of tools and dies who responded to a survey conducted by the Industrial Development Division several months ago. Of 41 metropolitan Atlanta purchasers of tools and dies who were interviewed, about half found lead time, quality, and cost satisfactory locally, and nearly all of the firms said quantity was not a problem. However, firms which purchased tools and dies from some distance away were dissatisfied with some or all of these factors. Although there is no lack of tool and die facilities, so many of them are small that it is difficult to get the speed required. Many die makers are not listed in the telephone directory, and potential customers are not aware of their existence. Several firms commented on the difficulty of getting precision work done. Others had specialized requirements which could be met only outside the state, such as very large dies, tools and dies for use in wire drawing and extruding, and the ability to handle aluminum.

Other Machinery. Service industry machinery manufacturers were concerned primarily with obtaining raw material. Specifics included late delivery, need for a closer supply of fractional horsepower electric motors and locks, and desire for a Georgia source of the type of steel used in their operations. Only two office machines producers were interviewed. One stated that he procured precision and investment castings from out of the state.

Conclusions and Recommendations

1. Nonelectrical machinery is one of Georgia's smallest industrial groups, and only modest growth is expected in the near future. Since about one-half of the plants have less than five employees each, only the simplest technological information will be useful to them. Respondents from all segments of the industry expressed interest in keeping up with technical progress in their fields, but such requests generally can be handled satisfactorily on an individual basis. In addition, these small concerns need assistance in nearly every phase of business management.

2. Finding, training, and keeping good workers is the industry's biggest problem. The area vocational-technical schools should not be overlooked as a source of trained workers. In addition to welding, 15 schools in the state offer machine shop training. Atlanta Tech also teaches machine drafting and design and machine tool technology (including N/C tools).

3. Some attention should be given to ways to improve the quality of work and the range of capabilities of the tool and die shops in the state. Their competence is very important to the future of metalworking in Georgia because their work is basic to so many manufacturing specialties. Most metalworking companies which consider Georgia as a location inquire about sources of good tool and die work.

4. Other segments of the nonelectrical machinery group for which special projects might be structured are textile machinery manufacturers and farm machinery producers, which together employ about 30% of the workers in the industry group. Farm machinery is an old, well-established industry in Georgia, with several companies founded in the 19th century. Some of these plants would benefit from a fresh approach to modernizing their products and production processes.

About 70% of the establishments which produce textile machinery are small (ranging from one to 50 employees each), including most of the tufted textile machinery manufacturers. Not having the research and development resources of the large firms, they can benefit from consultation with textile engineers and other experts in the University System. In order to stay ahead of the rapid obsolescence of machinery in this field, this group must keep abreast of research and development efforts on textile fibers and the resultant new products and processes that require new machinery, as well as meet the imperative need of textile mills to modernize their plants.

5. An analysis should be made of the future impact of N/C tool technology and the new metal cutting and forming methods on the entire nonelectrical machinery industry. Small firms should be apprised of those tools and techniques which are adaptable to their operations.

6. An effort should be made to bridge the communications gap which involves all phases of metalworking in Georgia, and cooperation should be encouraged between companies with complementary capabilities. The usefulness of a project to compile information on materials and services for which closer

sources of supply are needed, as well as firms with unused capacity in these areas or a desire to diversify, cannot be stressed too strongly in this regard. Job shops, in particular, need to find work to keep their employees busy during their slack periods. Because of the great degree of interdependence of the segments of the metalworking industry, knowledge of each other's capabilities and needs is necessary to build a strong metalworking base in Georgia and, as a result, to attract new metalworking plants in large numbers. Only then will the state attain its fair share of the higher-paying jobs which this industry offers.

* * *

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ELECTRICAL MACHINERY, EQUIPMENT, AND SUPPLIES
(Standard Industrial Classification 36)

The Industry in the United States

Identification

The electrical machinery, equipment, and supplies industry (SIC 36) in the United States consists of more than 10,000 establishments engaged in manufacturing machinery, apparatus, and supplies for the generation, storage, transmission, transformation, and utilization of electrical energy. Major segments of the industry center around the manufacture of (1) electric transmission and distribution equipment, (2) electrical industrial apparatus, (3) household appliances, (4) electric lighting and wiring equipment, (5) radio and television receiving sets, (6) communication equipment, (7) electronic components and accessories, and (8) miscellaneous electrical machinery, equipment, and supplies.

Composition

Approximately half of the more than 1.5 million workers in the nation's electrical machinery industry are employed in two segments of the industry -- communication equipment (32%) and electronic components (19%). The smallest segment of the industry -- miscellaneous electrical machinery, equipment, and supplies -- accounts for about 5% of total employment. The remaining employment is almost equally divided among five industry segments -- electric industrial apparatus, household appliances, lighting and wiring devices, electric distribution products, and radio and television receiving equipment.

Growth Pattern

Growth in the electrical machinery, equipment, and supplies industry has been relatively rapid in recent years, although somewhat below the pace set in the decade following World War II. Production increased at an average annual rate of 4.8% between 1957 and 1964, as compared with an average annual increase of 7.1% during the 1947-1957 period. Total value of shipments for the industry amounted to $31 billion in 1964, with over half of this output coming from three segments of the industry -- communication equipment, household appliances, and electronic components (2). Industry employment increased by almost a third

between 1958 and 1963, while value added by manufacture advanced from $10.6 billion in 1958 to $17.0 billion in 1963, an increase of 60% during the five-year period.

Technological Development

The electrical machinery, equipment, and supplies industry both creates and utilizes advanced developments in science, engineering, and technology. Research and development expenditures in the industry and its chief industrial customer -- communication services (SIC 48) -- reached $2.5 billion in 1963, an increase of 64% over 1956 outlays. In 1963, they accounted for 20% of the total research and development funds for all industry, second only to such outlays in the aerospace industry. About 63% of this research was financed by the federal government. Research and development expenditures will likely continue to rise to higher levels in future years. Among the areas of research are space technology, nuclear propulsion, laser technology, process control systems, and new products for home and industry, such as microwave cooking equipment, wall television sets, ultrasonic diswashers, video tape recorders, and medical electronic instruments (2).

Outlook

Output of the electrical machinery, equipment, and supplies industry is expected to continue to increase at an average annual rate of about 5% for the next few years. This rate of growth could accelerate if defense and space expenditures rise sharply and if exports of electrical machinery and equipment continue to grow. Industry employment should reach 2.0 million by 1975.

The industry's long-term growth potential is based on new and growing markets for electrical and electronic machinery, equipment, and supplies. In addition to the needs of the military and space programs, the demand for other products is expected to increase more rapidly than in the past because of rising levels of general economic activity and increasing requirements for electrical and electronic products. Some factors affecting this growing demand are the following:

1. Electrical equipment requirements in industrial plants are expected to raise the demand for electrical products such as motors, wiring, lighting, and industrial controls.

2. The demand for electrical equipment should be stimulated by improvements in urban transportation, the construction of atomic-powered electric utility systems, and the installation of underground transmission systems.

3. The mechanization and automation of many industrial processes will stimulate demand for electronic processes such as instruments, controls, and closed-circuit television.

4. The growing commercial market for electronic data processing equipment and other electronic products will greatly increase the demand for electronic components.

5. The rapid growth in population and family formation and the higher levels of personal spendable income are expected to provide booming markets for consumer and consumer-related items such as radios and television sets, electric light bulbs, and new home construction.

6. Electrical and electronic systems should play an increasingly significant role in telecommunications, underwater research, medicine, electroluminescence, and optical technology (1).

The Industry in Georgia

Composition

The electrical machinery, equipment, and supplies industry in Georgia is composed of approximately 85 manufacturers of electric transmission and distribution equipment (power transformers, electric signaling devices, control panels, switchgear and switchboard apparatus, electric service equipment, and power transmission equipment); electrical industrial apparatus (converters, electric motor coils, regulators, generators, electric outboard motors, industrial controls, and electric welding equipment); household appliances (outdoor stoves, ranges, heaters, vacuum cleaners, and rebuilt sewing machines); electric lighting and wiring equipment (residential and commercial lighting fixtures, lamps, fluorescent light guards, gas barricade lights, and telephone conductors); public address systems and phonograph records; communication equipment (telephone switching equipment, automatic signalling equipment, data communication equipment, outdoor television antennas, audio amplifiers, and electronic test equipment); electronic components and accessories (television picture tubes, magnetic computer tape, and electronic assemblies and components);

and miscellaneous electrical machinery, equipment, and supplies (storage batteries, automotive electrical wiring, generators, starters, armatures, automobile switches, and marine electronics equipment).

While each of the major segments of the electrical machinery and equipment industry is represented to some degree in Georgia, the relative importance of individual segments -- as measured by total employment -- differs significantly from the national pattern. Manufacturers of electric transmission and distribution equipment, for example, employ almost half of the electrical machinery and equipment workers in Georgia, whereas this segment accounts for less than 10% of the industry's total employment nationwide. Other segments which are relatively larger in Georgia than in the nation as a whole are those related to the manufacture of electric lighting and wiring equipment and miscellaneous electrical machinery, equipment, and supplies (primarily storage batteries and electrical equipment for automobiles).

As compared with the national pattern, Georgia is deficient in the manufacture of radio and television receiving equipment, electronic components, household appliances, communication equipment, and electric industrial apparatus. While communication equipment and electronic components, the two major segments of the industry in the United States, account for about half of the industry employment nationwide, they employ only slightly more than 10% of the electrical machinery and equipment workers in Georgia.

In sharp contrast to Georgia manufacturing generally, the state's electrical machinery and equipment industry is concentrated in those segments that are characterized by large firms, high wages, and high value added. Georgia firms in this industry average more than 100 employees each, and the largest segment -- manufacturers of electric transmission and distribution equipment -- averages more than 250 employees per firm. According to Bureau of Labor Statistics information, average weekly earnings in Georgia's electrical machinery and equipment industry in 1966 were 103.2% of the national average for the industry. In 1963, the Census of Manufactures reported that the industry's value added per employee in Georgia was $13,679, as compared with $11,252 for the industry nationwide.

Location

An analysis of listings in the 1966 Georgia Manufacturing Directory shows that manufacturers of electrical machinery and equipment are located in 30 of Georgia's 159 counties. Three counties in the immediate Atlanta area -- Fulton, DeKalb, and Rockdale -- account for almost half of the industry's total employment in the state, with firms in Floyd and Clarke counties employing another third of the total. Other counties with at least 300 workers employed in the industry are Hall, Henry, Muscogee, Decatur, and Telfair.

Growth Pattern

Except for temporary setbacks in 1949-1950 and 1958, which were related to general economic conditions, employment in Georgia's electrical machinery and equipment industry has increased consistently each year for the past two decades. During the same period, employment in the industry in Georgia grew slightly more rapidly each year (with one exception -- 1950) than did industry employment nationwide. Since the industry as a whole is not labor intensive, however, employment data alone tend to distort somewhat the significance of the total growth of the industry in Georgia. Between 1958 and 1963, for example, value added by manufacture of electrical machinery and equipment in Georgia increased 77%, while value added by the industry nationally increased 60% during the same period.

Trends

In the absence of evidence to the contrary, it is safe to assume that the electrical machinery and equipment industry in Georgia will continue its steady and consistent growth in the future. If Georgia retains its 1966 proportion of total U.S. employment in the industry, approximately 8,800 workers will be employed by the industry in the state in 1975. A more likely prospect is that Georgia will continue to increase its proportion of total industry employment. If the 1947-1966 trend continues, employment in Georgia's electrical machinery and equipment industry will reach approximately 12,400 in 1975.

Since no significant trends are evident in the growth of the various segments of the industry in Georgia, it is not possible to forecast with any degree of certainty that the composition of the industry in the state will change radically in the near future. However, those segments which are concerned with

the production of consumer goods -- particularly household appliances and radio and television receiving sets -- seem to have the best chance for the greatest relative growth as the expanding southeastern market takes on added importance. A major producer of household appliances has recently established a manufacturing operation in Georgia, but the state does not as yet produce radio and television receiving sets.

Industry Problems and Needs

Basis of Analysis

The following analysis of the problems and needs of the electrical machinery, equipment, and supplies industry in Georgia is based on personal interviews with managers and operators of 15 plants in the state, the responses of representatives of 13 firms to a mail survey of problems and needs, and the experience of Industrial Development Division staff members in working with Georgia business and industry for more than 11 years.

Nontechnical Problems and Needs

Although the industry is highly technical, many of the problems and related needs for information, service, and assistance in Georgia's electrical machinery and equipment industry are not directly concerned with the fields of science, engineering, and technology. The organization and management of manpower, financial resources, production processes, and marketing functions are areas in which most firms in the electrical machinery and equipment industry recognize the need for improvement.

Problems and needs in these nontechnical areas are not peculiar to the industry nor can they be related to the particular characteristics of the various segments of the industry. In order of frequency of mention, these problems and needs are concerned with developing supervisory and middle management personnel, recruiting and training production employees, cost control, inventory control, sales promotion, market information, accounting methods, distribution channels, employee relations, absenteeism and turnover, sources of capital, sources of raw materials, diversification, organizational planning, and general management methods.

Technical Problems and Needs

The needs of firms in the electrical machinery and equipment industry for technical information and service vary widely and follow no consistent pattern either for the industry as a whole or for individual segments within the industry. Many of the larger, more sophisticated firms thrive on new developments in technology but generally feel little need for outside assistance, relying primarily on their own research and development capabilities. Other firms can identify general areas in which technical information and service might be useful, while still others have very specific technical needs which apply principally to the particular firm rather than to the industry generally.

General areas of operation in which technical assistance would be most helpful were identified by one or more firms in the industry to be quality control, product development, production scheduling, maintenance of equipment, production methods, plant layout, and research and development.

Individual firms expressed interest in technical information on new developments in such diverse and specific subject areas as heliarc welding of aluminum, plating processes, uses of metals, electrical conductors, metal coatings, tape reproduction, molded plastics, plating and soldering of printed circuits, techniques of transfer design, procedures and methods for thermometer calibration, high vacuum techniques as related to electronics manufacturing, procedures for hydrogen annealing of electromagnetic materials, corrosion problems on certain alloys, soldering techniques, frequency measuring equipment, frequency standards, synthesizers, frequency dividers, and coil winding and magnetism.

Conclusions and Recommendations

1. The electrical machinery, equipment, and supplies industry in Georgia differs from most other manufacturing categories in the state in that it is characterized by large firms and wage rates and value added per employee that are higher than the national averages for the industry. These unusual features of the industry contribute significantly to the conclusions and recommendations which follow.

2. Growth of high-wage industries to counterbalance the effect of the predominance of low-wage industries in Georgia is essential if the state's per

capita income is to increase at a rapid enough pace to reach the U.S. average within the foreseeable future. It is concluded, therefore, that a special effort should be made under the State Technical Services program to stimulate the technical advancement and expansion of the electrical machinery and equipment industry in Georgia.

3. Many large plants in the electrical machinery and equipment industry in Georgia are branches of major national firms which have corporate research and development capabilities (General Electric, Westinghouse, Federal Pacific Electric, Philip Carey Manufacturing, Square D Company, I-T-E Circuit Breaker Company, Link-Belt, Leece-Neville, Cutler-Hammer, Sunbeam, Electric Storage Battery, ELTRA Corporation, etc.). It is unlikely that the Georgia Technical Services program could serve these firms on a local basis.

4. However, other relatively large, highly sophisticated firms in Georgia's electrical machinery and equipment industry are locally operated (Scientific-Atlanta, Lithonia Lighting, Cleveland Electric, Southern States, Kay-Townes Antenna, RMS Engineering, etc.). Although most of these firms have research and development capabilities, they could benefit from specialized and concentrated technical information and service under the State Technical Services program. Several of these companies should be prospects for participation in the Advanced Technology Applications Center program (State Technical Services Special Merit project of the Board of Regents).

5. As evidenced by the many specialized problems and needs specified above, other firms in Georgia's electrical machinery and equipment industry are seriously interested in specific technical information and assistance. Since these needs are more closely related to company situations than to industry-wide problems, it is concluded that these needs could best be served on an individual firm basis as part of a general industrial extension service under Georgia's State Technical Services program.

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INSTRUMENTS AND RELATED PRODUCTS
(Standard Industrial Classification 38)

The Industry in the United States

Identification

The industry group which is commonly referred to as the instruments and related products industry is officially designated in the Standard Industrial Classification Manual as the professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks industry (SIC 38). Nationwide, this industry consists of more than 4,000 establishments engaged in manufacturing mechanical measuring, engineering, laboratory, and scientific research instruments; optical instruments and lenses; surgical, medical, and dental instruments, equipment, and supplies; ophthalmic goods; photographic equipment and supplies; and watches and clocks.

Composition

Slightly more than half of the more than 300,000 workers in the nation's instruments and related products industry are employed in two segments of the industry -- instruments for measuring, controlling, and indicating physical characteristics (31%) and photographic equipment and supplies (21%). In order of percentage of total industry employment, the other segments are surgical, medical, and dental instruments and supplies (17%); engineering, laboratory, and scientific and research instruments and associated equipment (11%); watches, clocks, clockwork-operated devices, and parts (10%); ophthalmic goods (7%); and optical instruments and lenses (4%).

Growth Pattern

Output in the instruments and related products industry increased at an average annual rate of 4.8% between 1957 and 1964, below the industry's average annual growth rate of 6.2% between 1947 and 1957, but still above the rate of growth for all manufacturing. Growth trends of individual segments of the industry have varied considerably, resulting from different market demands for the various products of the industry and from differing rates of technological innovation. Production of scientific, industrial, and technical instruments increased consistently throughout the entire 1947-1964 period and at a considerably higher rate than that for the industry as a whole. Output of surgical,

medical, and dental instruments increased relatively more slowly, and the production of watches and clocks declined (1).

Outlook

The principal area of advancing technology in the instruments and related products industry is likely to continue to be product innovation, including the development of instruments of greater accuracy and reliability, smaller size, and increased sensitivity. Manufacturers in this industry also are expected to give increasing attention to the use of laborsaving techniques, such as numerical control, in their manufacturing operations. Increases in instrument output and employment are anticipated for the next several years in response to increasing market demand resulting from greater industrial automation, growth of research and development, and expansion of space and defense programs (1).

The Industry in Georgia

Composition

The instruments and related products industry in Georgia consists of a small and somewhat heterogeneous group of 36 firms ranging in size from two to about 700 employees. More than 70% of the total employment in the industry is concentrated in three establishments, each of which employs more than 400 workers. In contrast, 25 of the 36 firms have fewer than 25 employees, and all but the three large firms employ less than 75 workers.

While each of the major segments of the industry is represented to some degree in Georgia, the relative importance of individual segments -- as measured by total employment -- differs significantly from the national pattern. Manufacturers of watches, clocks, clockwork-operated devices, and parts employ more than half of the instruments and related products workers in Georgia, whereas this segment employs only about 10% of the industry's workers nationwide. The fact that two of the three large firms in Georgia are classified in this segment accounts for the predominance of this industry segement in the state. The influence of the third large firm makes the manufacture of mechanical measuring devices the second largest segment of Georgia's instruments and related products industry.

The largest concentration of firms and the third largest concentration of employment in the industry in Georgia are in that segment which is involved in

the manufacture of surgical, medical, and dental instruments and supplies. In order of employment size, the other minor segments in the state are those producing ophthalmic goods (8% of total employment); engineering, laboratory, and scientific and research instruments and associated equipment (3%); optical instruments and lenses (3%); and photographic equipment and supplies (2%).

Location

Manufacturers of instruments and related products are located in only 16 of Georgia's 159 counties. Employment in the industry is concentrated in Clarke County, where two of the three large establishments are located. Bulloch County, site of the third large firm, is second in industry employment, followed closely by the Atlanta area (Fulton, DeKalb, and Clayton counties), where half of the industry's firms but only 16% of its workers are located. Other counties with some employment in the industry are Newton, Muscogee, Randolph, Coweta, Richmond, Dawson, Douglas, Crisp, Chatham, Oglethorpe, and Floyd.

Growth Pattern and Trends

Due to the limited size of the instruments and related products industry in Georgia, growth patterns and trends can not be reliably identified except in terms of specific happenings and known developments. Because of the influence of the three large firms on the total activity of the industry, much of the overall industry growth can be related to the expansion of these firms, particularly those producing watches, clocks, clockwork-operated devices, and parts.

In the recent past, there has been significant growth in that segment of the industry which is concerned with the manufacture of surgical, medical, and dental instruments and supplies. Expansion of an existing firm in Columbus and the establishment of a new plant in Covington have added to the state's output of hospital and surgical equipment and specialties. Continuation of this growth is assured by the announcement of a new $5 million, 300-employee establishment in Augusta, which is scheduled to be in production by late summer of 1968. The heterogeneity of this industry group is demonstrated by the fact that this new operation will produce surgical dressings -- a product which is properly classified in the instruments and related products industry, but which differs radically from the hardware which is normally associated with the industry.

Industry Problems and Needs

Basis of Analysis

The following analysis of the problems and needs of the instruments and related products industry in Georgia is based on personal interviews with managers and operators of nine plants in the state and the responses of representatives of five firms to a mail survey of problems and needs.

Nontechnical Problems and Needs

Individual firms in this relatively small industry apparently recognize the need for information and assistance in several nontechnical areas, none of which are peculiar to the industry as a whole. In order of frequency of mention, these problems and needs are concerned with training employees, developing market information, identifying new sources of raw materials, establishing more efficient inventory control methods, securing trained personnel, promoting sales, and planning a program of diversification.

Technical Problems and Needs

The needs of firms in the instruments and related products industry in Georgia vary widely and follow no consistent pattern either for the industry as a whole or for individual segments within the industry. The few large firms rely primarily on their own technical staffs to keep abreast with the state of the art and to identify and apply new technological developments. Other firms can identify general areas in which technical information and service might be useful (research and development, production methods, quality control, etc.), while others have very specific needs which apply principally to the particular firm rather than to the industry generally.

Individual firms expressed interest in technical information on new developments in such general and specific subject areas as metallurgy, extruded aluminum tubing, thermoplastics and leather substitutes, optical processing equipment, waterproof coatings for leather that will not affect pliability, plastic and metallic finishes for metals, properties of plastics for use in the manufacture of precision machine parts, and adhesives for plastics.

Conclusions and Recommendations

1. The three large plants in the instruments and related products industry in Georgia are branches of major national firms which have corporate research and development capabilities (Westclox Division of General Time Corporation, Precision Products and Parts Division of General Time Corporation, and Statesboro Division of Rockwell Manufacturing Company). It is unlikely that the Georgia Technical Services Program could serve these firms on a local basis.

2. Some of the remaining firms in this small industry group apparently are interested in specific technical information and assistance. The problems and needs of these firms are not sufficiently homogeneous to attack on a group project basis, however. It is concluded, therefore, that these needs could best be served on an individual firm basis as part of a general industrial extension service under Georgia's State Technical Services program.

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REFERENCES

1. U. S. Department of Labor. Technological Trends in Major American Industries, Bulletin No. 1474. February 1966.